United States–Ghana Consultative Cooperative Agreement on Agriculture and Rural Development (CCARD)

Training and Analysis Assistance in Building Capacity for Agricultural Marketing and Exporting in Ghana

Transportation and Post-Harvest Handling Assessment

March 2002

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Executive Summary

A transportation and post-harvest handling assessment, the results on which this report is based, took place from March 11-15, 2002 in and around Accra, Ghana, and was conducted by USDA personnel in response to a request from the Market Access Working Group of the United States-Ghana Consultative Cooperative Agreement on Agriculture and Rural Development (CCARD). According to published sources, fresh produce exports between the United States and Ghana at present are relatively low and move mostly by sea.

There were three main objectives during the post-harvest/transportation assessment:

- to identify constraints in the movement of produce from farm to market or "bottlenecks,"
- to identify the causes and sources of post-harvest losses and quality problems, and
- to identify training priorities and participants.

Stakeholder interviews were conducted and field visits were made to farms, packinghouse operations, and port facilities, using a modified Commodity Systems Assessment Method. Interviewees had a wide range of knowledge and experience with many different aspects of handling and shipping produce in Ghana. Findings were organized into categories related to pre-harvest factors, harvest, curing, packinghouse operations, cooling, storage, transport, destination handling, and agro-processing. Findings indicate that in general the post-harvest handling practices used for domestic produce marketing are rudimentary at best, and produce is not well packaged or protected from damage during handling. Handling for export is somewhat improved overall, with better quality packages and pest management practices in use, and quality standards identified and followed based upon the intended market.

The assessment findings pinpointed a variety of areas where handlers are typically experiencing problems and bottlenecks in moving produce from the farm to the ports and markets in Ghana. Exporters commonly experience a 25 to 35 percent loss in exportable yield (produce that does not meet export market specifications) and produce intended for the domestic market is estimated to have post-harvest losses of 35 percent or more. The assessors believe that significant improvements in produce quality, safety, and shelf life and improved profits could be

achieved if handlers were to adopt some simple, low-cost, post-harvest handling and transportation practices.

Three topic areas emerged as key problems and the source of bottlenecks and high costs in the Ghanaian post-harvest handling and transportation system currently in use for moving high quality fruits and vegetables from the farms to the markets or ports.

- Preparation for market
- Cooling practices
- Transportation

A "Training the Trainers" program has been developed by the assessors to focus upon these and other related produce handling and transportation issues. Three modules are proposed:

- Module 1: Harvest and Preparation of Fruits and Vegetables for Market
- Module 2: Cooling Practices and Relative Humidity Management for Fresh Produce
- Module 3: Improving the Transportation of Fruits and Vegetables in Ghana

Preparation for market includes harvesting, packinghouse operations, pest management, food safety and packaging. Harvest indices are available for most commodities and assist growers to identify the exact stage of maturity that will result in the longest shelf life, natural pest resistance, and good eating quality. Grades and standards exist for commodities intended for the U.S. market, and new requirements in Europe and the United States regarding food safety could become a major barrier if handling does not conform to international standards.

Cooling practices were nearly entirely absent in Ghana, even regarding the basics of removing field heat and protecting produce from heat gain during handling and transport. A training module on cooling will introduce low cost practices that can be used to cool produce to 15 C before packing and to protect produce from heat gain during shipping.

While cooling is currently perceived to be too costly to Ghana's produce handlers, training in post-harvest practices can assist handlers in understanding that not cooling can be even more expensive in terms of produce losses (weight and quality) and decay incidence during long-distance shipping. Since these problems will impact directly on the marketability and value of Ghana's produce in the European Union and the United States, ignoring cooling will serve to ensure that Ghana cannot compete with other producers on the world market.

Many exporters rely on "just-in-time" delivery as a means of avoiding cooling, but transport of produce in Ghana is often delayed by poor roads, traffic accidents, break-downs and/or bad weather, and vehicles tend to be hired on an as-needed basis, so vehicles may or may not be well-suited for produce transport. Handling at the ports can also be delayed due to late arrivals, worker shortages, weather problems or high volumes arriving in a short period of time. A training module on **transportation of horticultural commodities** will include the practices of proper sanitation, loading/unloading, stacking, management of transport scheduling, consolidation, handling mixed loads, and strategies for reducing transport costs.

These three topic areas will be developed into individual training modules consisting of written, video, slides and demonstration materials that will be presented as a 3 day-long "training of trainers" program. The updated *Small Scale Post-Harvest Handling Practices: A Manual for Horticultural Crops* will be used as the basis of the "training the trainers" program.

The commodities selected for the focus of the training will be limited to those currently identified by MoFA officials and Ghana's grower/exporters as viable crops, with the addition of a few related commodities that may be of interest in the near future. The commodities represent a range of produce, from those that are quite difficult to handle to those that are relatively simple. MoFA and related agencies in Ghana should perform standard market research studies before recommending any specific commodity to growers for export purposes.

- Pineapple
- Papaya
- Mangoes
- Yams
- Chilies
- Sweet potato
- Eggplant
- Okra
- Ginger
- Watermelon
- Green beans/long beans
- Avocado

A three-day long training program is proposed to be held near Kumasi, Ghana during early September, 2002. If the logistics are found to be too difficult to set up a training program in this location, the Accra could be selected as an alternate site, since the Accra has been the more traditional location for past training programs in horticulture. Key trainees are personnel from the Ministry of Food and Agriculture need to be identified and trained to take the lead as Subject Matter Specialists in post-harvest handling and transportation of fresh produce. Trainees should meet qualifications such as:

- have ability and willingness to share gained information with others in the industry,
- be in direct contact with many others in this industry,
- have a sincere interest in working to improve the industry as a whole,
- have prior knowledge and skills in the area of post-harvest handling and transport,
- have some experience in providing formal or informal instruction to others, and
- have a need to share this information with their producers and suppliers.

This report also presents an overview of how CCARD might address the other related topics that arose from the assessment (see Secondary Findings) and provides many resources for following up on expressed training needs and making progress along the path toward international fresh produce marketing (see Appendices).

Background of the Project

The United States of America and the Republic of Ghana Consultative Committee on Agriculture and Rural Development (CCARD) agreement was signed at a meeting between the U.S. Department of Agriculture (USDA) and Ghana's Ministry of Food and Agriculture (MOFA) in Accra, Ghana on June 29, 2000. The purpose of the CCARD, as stated in the Terms of Reference, "is to provide continuous and consistent high-level engagement between MOFA and USDA to strengthen agricultural and rural development…through carefully articulated articles of cooperation and coordination."

In order to meet these objectives, the Terms of Reference encourages the establishment of working groups to focus efforts in specific areas determined by the CCARD co-chairpersons. During the November 2000 CCARD meetings, three specific areas were defined and working groups were developed:

- Institutional and Human Resources Rural Development Working Group
- Market Access Working Group
- Natural Resources Working Group

Under the topic of "Market Access" various specific areas were defined as needing assistance from the United States, including the post-harvest handling and the transportation of fresh fruits and vegetables. The very high cost of transportation and lack of proper post-harvest agricultural handling practices are believed to be two of the largest constraints restricting Ghanaian economic growth, United States-Ghana bilateral trade, the Ghana-European trade and West African inter-regional trade. The Agricultural Marketing Service (AMS) of USDA was invited to submit a proposal to offer training in these specific areas.

The original proposal for $180,000, which included study tours and multiple in-country workshops, was approved, but funding was cut to $60,000. The proposal was therefore amended to include an in-country assessment and a "training the trainers" type program to be held in Ghana, based on the findings of the assessment. Added to this proposal is the update of "Small Scale Post-Harvest Handling Practices: A Manual for Horticultural Crops," to be used as the basis of the "training the trainers" program.

Once the proposal was accepted by the CCARD Working Groups, AMS began to organize plans for the assessment. Preparation for the assessment and the collection of statistical data began in early March 2002. The in-country assessment, the results on which this report is based, took place from March 11-15, 2002 in and around Accra, Ghana and was conducted by Heidi Reichert, Economist and transportation specialist in the Transportation Services Branch of AMS and Lisa Kitinoja, Principal Consultant, Extension Systems International and small-scale post-harvest specialist.

Agricultural Import/Export Statistics

The vast majority of U.S. containerized exports to Ghana in 2001 were shipped by Catholic Relief Service (71%) while commercial products moved mainly via Maersk-SeaLand (table 1). Grains accounted for 60% of exports, while the remainder was mostly poultry (14%) and vegetable oils (11%), all moving through the port of Tema. Shipments in 2001 originated in Lake Charles (71%), Charleston (9%), New York (6%) and Houston (5%). Charleston (41%) Houston (16%) and New York (13%) accounted for much more volume in 1999. The total volume of containerized imports was low, with only 613 TEUS from the United States arriving in Ghana during 2001. The remainder of exports from the United States to Ghana, a total of 197 metric tons of bulk cargo, was 97 percent wheat, rice and other food grains.

Maersk-SeaLand also handled the majority of containerized agricultural products exported from Ghana to the United States in 2000 (79% market share). See table 2. Cocoa products accounted for 67 percent of the total shipped, vegetables (mostly yams and eggplant) were 13 percent and pineapples only 1 percent. The total volume exports to the United States were also low, with 815 TEUs shipped during 2000. The remainder of exports to the United States from Ghana, a total of 34.2 metric tons of bulk cargo, was 92 percent raw cocoa beans.

There are at present no air shipments of fresh produce from Ghana to the United States and there are no direct international flights from Ghana to the United States and no USDA inspection facilities available for exporters at the airport.

Table 1: U.S. Agricultural Exports to Ghana – 2001

Commodity	TEUS*	Market Share
Wheat	274	45%
Soybean/wheat blend	91	15%
Frozen poultry	85	14%
Vegetable oil	69	11%
Foodstuffs	51	8%
Rice	9	1%
Wine	9	1%
Spices	7	1%
Margarine	4	1%
Other	14	2%
Total	613	100%

Shipping Line	TEUS*	Market Share
Bulk (Catholic Relief Service)	433	71%
MaerskSeaLand	118	19%
P&O Nedlloyd	30	5%
Mediteranean	12	2%
Torm Lines	9	2%
Hapag Lloyd	5	1%
Zim Line	4	1%
COSCO	1	0%
Total	613	100%

U.S. PORT	TEUS*	Market Share
Lake Charles	433	71%
Charleston	56	9%
New York	39	6%
Houston	31	5%
Norfolk	18	3%
Savannah	13	2%
Oakland	10	2%
Long Beach	8	1%
New Orleans	5	1%
Total	613	100%

Transshipment Port	TEUS*	Market Share
Algeciras	107	69%
Freeport	10	6%
Rotterdam	8	5%
Le Havre	8	5%
Singapore	5	3%
Salalah	4	3%
Bremerhaven	3	2%
Cape Town	3	2%
Gioia Tauro	2	1%
Antwerp	2	1%
Barcelona	1	1%
Haifa	1	1%
Genoa	1	1%
Total	155	100%
% Transshipment	25%	

Ultimate Port	TEUS*	Market Share
Tema	612	100%
Takoradi	1	0%
Total	613	100%

Bulk Shipments

Commodity	Pounds	Metric Tons
Wheat	257,123,293	116630
Rice	162,409,599	73669
Poultry	11,353,829	5150
Lentils	4,408,869	2000
Mackerel	944,768	429
Planting seeds	12,065	5
Wheat/soybean mix	3,763	2
Total	436,256,186	197885

Source: Port Import Export Reporting Service (PIERS), Journal of Commerce, NY, 2001
**Twenty-foot equivalent units*

Table 2: U.S. Agricultural Imports from Ghana –2000

Commodity	TEUs*	Market Share
Cocoa butter/powder	239	29%
Cocoa Shells	186	23%
Cocoa Beans	120	15%
Vegetables (eggplant/yams)	108	13%
Frozen tuna	72	9%
Foodstuff/grocery items	63	8%
Fresh pineapple	6	1%
Spices	5	1%
Coconut husk fiber	4	0%
Palm oil	3	0%
Potato starch	3	0%
Flour (cocoyam/fufu)	3	0%
Fruit drink concentrate	1	0%
Grated Cassava	1	0%
Total	815	100%

Shipping lines	TEUs*	Market Share
MaerskSeaLand	640	79%
Torm Lines	138	17%
P&O Nedlloyd	20	2%
COSCO	6	1%
Yang Ming	4	0%
Wallenius Welhelmen Lines	4	0%
Meditteranean	2	0%
South African Marine	1	0%
Total	815	100%

Ultimate Port	TEUs*	Market Share
Tema	430	53%
Takoradi	377	46%
Ghana	8	1%
Total	815	100%

Transshipment Port	TEUs*	Market Share
Algeciras	567	84%
Halifax	72	11%
Felixstowe	20	3%
Rotterdam	6	1%
Genoa	6	1%
Cape Town	2	0%
Total	673	100%
% Transshipment	83%	

Bulk Shipments

Commodity	Pounds	Metric Tons
Raw cocoa beans	69,513,722	31531
Millfeed	5,976,725	2711
Total		34242

Source: Port Import Export Reporting Service (PIERS), Journal of Commerce, NY, 2000
**Twenty-foot equivalent units*

Assessment Objectives and Methods

Assessment Objectives

There were three main objectives during the post-harvest/transportation assessment:

- to identify constraints in the movement of produce from farm to market or "bottlenecks,"
- to identify the causes and sources of post-harvest losses and quality problems,
- to identify training priorities and participants.

Every industry is constantly trying to improve its processes, making them smoother, faster, and more cost-efficient, while constantly supplying a better product. There is always room for improvement in each system, and every system has bottlenecks. The fresh produce industry in Ghana is no exception, especially as it begins to reach out toward the goal of increasing exports to the United States and European countries. Recognizing that the current system for handling produce is not adequately meeting international quality and safety standards, this assessment was requested. By meeting with key industry representatives and making site visits, bottlenecks in the current post-harvest handling system were identified.

Identifying bottlenecks and causes or sources of post-harvest losses and quality problems is only the first step in making improvements. After identifying these problems, priorities can then be determined as to which areas can be addressed immediately by handlers and which must be addressed through on-going training and demonstrations of alternative practices. Priority training needs are those which will result in handlers gaining practical information on how to reduce post-harvest damage and physical losses, protect produce quality and safety during handling, reduce handling costs, and improve profits.

Throughout the interviews and site visits, the assessors were interested in identifying which individuals and organizations should be invited to the planned "training of trainers" in post-harvest handling and transportation practices. Those organizations should be able to recommend trainees who can meet qualifications such as:

- have ability and willingness to share gained information with others in the industry,
- be in direct contact with many others in this industry,
- have a sincere interest in working to improve the industry as a whole,
- have prior knowledge and skills in the area of post-harvest handling and transport,
- have some experience in providing formal or informal instruction to others, and
- have a need to share this information with their suppliers.

Assessment Methods

For the assessment, interviews of key stakeholders and site visits (identified by MoFA and the U.S. Embassy) were arranged. As requested by the assessment team, interviews were arranged with individuals representing governmental, quasi-governmental, non-governmental, and private agencies and operations. Meeting with and interviewing a variety of stakeholders provides an

excellent opportunity to pinpoint issues and focus in on key areas. Such interviews and site visits also allowed the assessment team to hear and see personally from those directly involved in the transportation and post-harvest handling system. During the interviews, the stakeholders were asked to describe the existing system and identify what they saw to be bottlenecks and problem areas. The assessment team probed in the effort to ensure the information provided was correctly understood. Detailed and lively discussions between the assessment team and the stakeholders about the issues facing the industry occurred frequently.

In only five days, it was impossible to meet with every key stakeholder; therefore, since only representatives from the different aspects of the industry were present, many findings and conclusions are based on anecdotal stories and opinions by specific persons. Without the ability to address a wider range of industry stakeholders, representing different regions of the country, it is difficult to assess which issues are specific to certain companies, products, regions, or routes and which are industry-wide.

The assessment team was able to collect a large range of valuable information about the post-harvest and transportation industry in Ghana and the issues it is facing. Most of the information fits the general pattern of typical post-harvest handling problems and transportation issues found in developing countries worldwide. In addition, it is known that all fresh produce for export from Ghana, no matter where its origin, must eventually move to the ports at Tema or Kotoka. With this information, the assessment team was able to successfully identify key bottlenecks and prioritize topic areas for training. Therefore, although the specifics were collected in and around Accra, the results of the assessment can be applied to moving and handling produce in Ghana as a whole.

Commodity Systems Assessment Methodology (CSAM)

This post-harvest loss assessment method sets the stage for developing productive post-harvest training programs by assessing the technical, socio-economic, cultural, and institutional factors related to handling a given commodity in a specific locale. The end products of CSAM encompass both traditional loss assessment and cost/benefit analysis and lead to more practical and useful training programs.

Ideally, teams of people work together while investigating any commodity system–for example, a horticultural professional and an extension agent might be teamed up with an economist or a marketing specialist, and meetings would then be held with people who are directly involved in handling the crop in the field, during shipping and marketing. In this case we used a team of two–a post-harvest horticulture specialist and an economist with a specialization in transportation. The process of CSAM can help to build links between agencies and individuals, identify bottlenecks and information gaps and help people solve problems while focusing on usable post-harvest technology.

The commodity system is made up of 28 components that together account for all the steps associated with the production, post-harvest handling and marketing of any given commodity. See Appendix B for the outline and sample questions. A variety of key aspects are related to the initial quality of any commodity and factors that affect its handling within the commodity system are summarized here. The training needs assessors make direct observations and measurements of practices and outcomes during a series of field visits. (Sites are listed in Appendix C). Some of the questions could be answered directly by extension personnel or others who are knowledgeable about the commodity, or information can be found in available literature from MoFA and other Ministries in Ghana. Other questions required the data collection team to observe actual post-harvest handling practices and ask questions of those people who harvest, handle, and market the product. Information on the costs and expected benefits of various post-harvest technologies were collected directly or estimated from applied or adaptive research studies. Face-to-face interviews and group meetings with clientele focused on those specific topics of interest that fell within each person's actual pre-production, production, post-harvest, and/or marketing activities or their area of expertise.

Expected outcomes of CSAM

CSAM can assist a post-harvest technology training assessment team to determine: 1) the sources of post-harvest losses and bottlenecks (when, where and who within the marketing chain is responsible), 2) the causes of those losses and bottlenecks (what handling or marketing practices are responsible) and 3) the economic value of the losses compared to the costs of current and proposed post-harvest practices. Once this kind of information has been collected, we can target the responsible handlers with appropriate training and information on cost effective, improved post-harvest technical practices.

In the occasional situation where there is no existing appropriate technical solution for the handling or marketing problem uncovered using CSAM, the problem can be passed on to horticultural researchers in the universities or regional agricultural research centers. The more information provided regarding the commodity system, the better chance the researchers will have to identify solutions that are appropriate to the specific socio-economic and cultural setting where the post-harvest losses occur.

Meetings and Site Visits

Due to the short period of time available for the assessment, the field visits and interviews were conducted in offices and sites in the Greater Accra, Eastern and Central Regions. Interviewees included government facilities, private large-scale commercial and smaller scale operations, grower/marketer associations, and facilitating services. Growers and marketers, ministry officials, and service personnel represented a wide range of opinions and ideas and were familiar with the many aspects of moving produce from the interior as well as from the coastal areas to Ghana's ports and domestic markets. See Appendix C for a complete list of site visits and interviews.

Assessment Findings

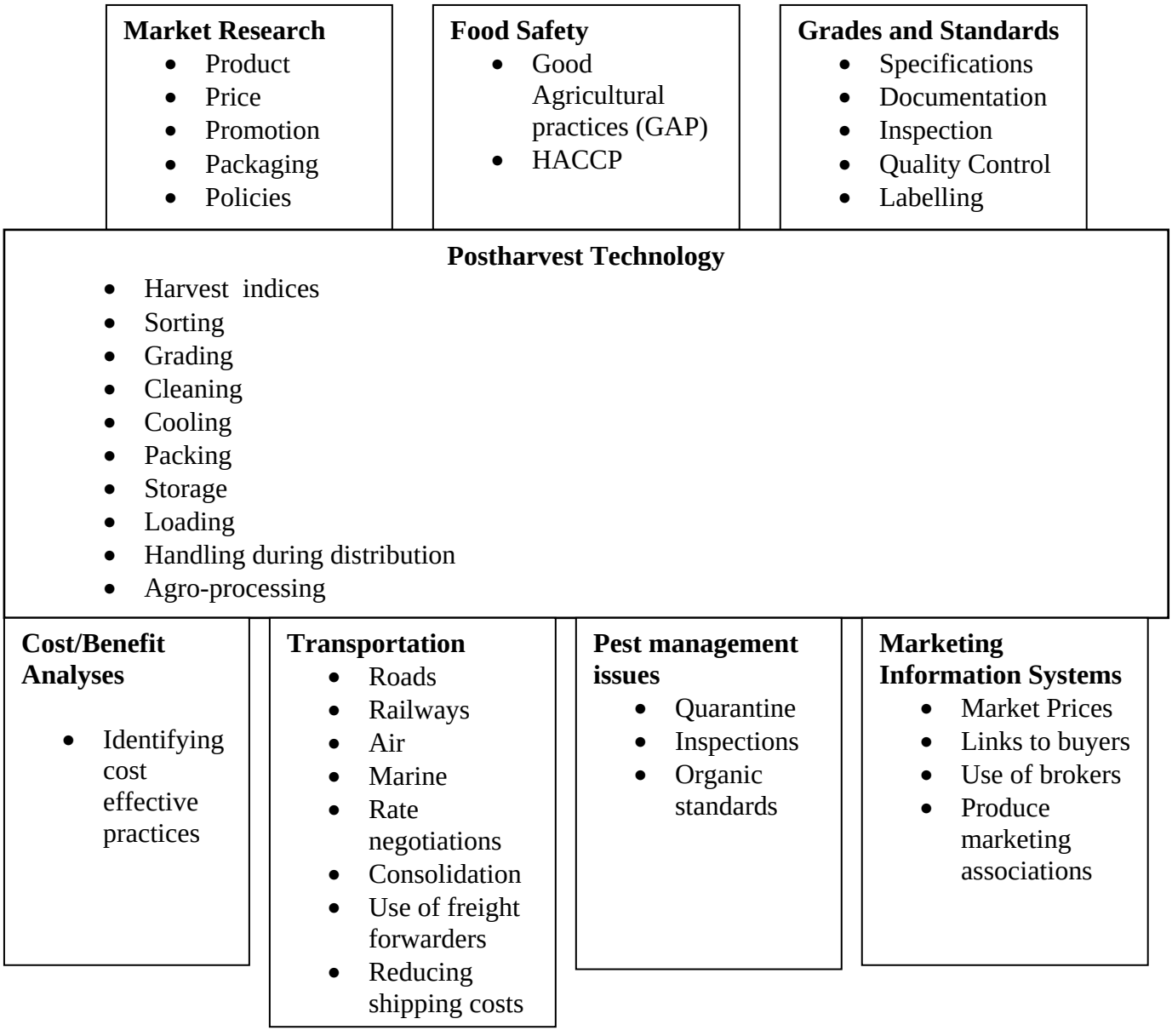
Overview

In general, the descriptions by stakeholders of the post-harvest handling and transportation system in use in Ghana during the assessment were highly consistent with the systems found in developing countries worldwide. Although post-harvest handling and transportation was the focus of the assessment (see Primary Findings), several related topic areas kept arising in the interviews with stakeholders (see Secondary Findings).

Figure 1(a) illustrates the relationship between all these topic areas, each of which must be addressed before Ghana's growers and exporters are fully prepared for meeting the challenges of exporting fresh produce in any large volume to the United States or any other country. Only a few can be addressed in the proposed training program (see Training Priorities), and others have been the focus of recent USDA (Grades and Standards training, and phytosanitary training programs) or USAID (ATRIP--marketing links and organizational development for grower/marketer cooperatives) efforts in Ghana.

Figure 1a: Overview of Expressed Training Needs in Ghana

Training Needs for Fruit and Vegetable Exporters from Ghana



Primary Findings (Post-Harvest Systems)

Pre-harvest factors affecting post-harvest quality

Typical pre-harvest factors that have been found to affect produce quality include the following:

- Inadequate planning regarding planting and harvesting dates.
- Growing cultivars that mature when market prices are lowest.
- Production of cultivars with high yields but short post-harvest life or susceptibility to post-harvest pests and diseases.
- Problem obtaining high quality planting materials.
- Over-fertilization of vegetables with nitrogen.
- Inappropriate irrigation practices (too little water, too much or mistiming).
- Poor orchard and field sanitation leading to latent infections and insect damage.
- Lack of pruning and propping of limbs leading to damaged fruit trees
- Lack of thinning fruits leading to small sized fruits with non-uniform maturation.
- Lack of pest management (spraying for insect or fungal control, or bagging produce susceptible to insect or bird damage).

In Ghana, our assessment determined that most of these problems were encountered with one commodity or another. Produce gluts were reported to be common on the domestic market, with prices dropping precipitously whenever a large amount of produce of any one kind arrives at the market during a short period of time.

Vegetable Producers and Exporters Association of Ghana (VEGPEAG) members indicated that obtaining good quality planting materials was one of their major bottlenecks. They had orders for more produce than they could grow because of problems with obtaining sweet potato vines and lack of seeds for the proper varieties of okra and chili peppers. When growers cannot find or afford planting materials, they resort to using their saved seeds or roots, which can be of questionable quality and lead to lower yields and lower quality produce.

Sweet potato vines had recently been imported from South Africa, but due to their multiplication in open fields, many had been lost when they succumbed to a viral infection. Members explained that it is very difficult to procure good quality seeds, since they must be imported, tend to be expensive and may not always suit the climate and production conditions in Ghana. The solution, members believe, is to establish local nurseries and develop local seed and plant multiplication capability.

Pineapple growers appear to have their farming operations, including forcing practices, planned and implemented to match their shipping schedules. Papaya growers were aware that thinning fruits that will not meet quality specifications could improve their exportable yields. Still, pineapple and papaya growers reported that 25 to 35 percent of their produce at times must be diverted to the domestic market when it doesn't meet export specifications or because harvest volumes are higher than intended on a particular day.

MoFA's estimates of productivity for selected commodities (those available are listed in Table 3 below) indicate that yields are much lower than the potential under rain-fed conditions for

mangoes, cassava, and sweet potatoes. Papaya yields obtained at present by growers in Ghana are much closer to their potential.

Table 3: Estimates of Productivity for Selected Commodities			
Crop	**Yield Rain-fed (T/HA)**	**Yield Irrigated (T/HA)**	**Potential Yield, Rain-fed (T/HA)**
Mango	5		25
Papaya	65		75
Cassava	12.3	30	25
Yam	13.38		
Sweet Potato	8	15	18

Source: Ministry of Food and Agriculture, Ghana, 2002

During the assessment we were informed many times that the Afram Plain had the best natural potential for fresh fruit and vegetable production in all of Ghana, but few export growers are currently active there because the roads are so poor and transport is unreliable.

Average temperatures, all year around, are between 75 and 84 F (25 and 29 C), and it is nearly always humid in the south and middle regions of the country, making pest management more difficult. The traditional rainy seasons vary by latitude, but are known to be unpredictable, as in Table 4 below:

Table 4: Rainy seasons in Ghana	
Location	**Rainy Season (s)**
Coast/South	April–June October–November
Mid-zone (interior forests)	March through July or August October–November (Heavier rainfall than on the coast)
North	May through September (Rainfall may not begin until June or July)

Harvest

Some of the most common causes and sources of post-harvest problems that are related to harvest include the following, and all were found in Ghana:

- Harvesting at improper maturity leading to increased severity of physiological disorders and water loss, lower eating quality (poor flavor and/or texture), failure to ripen or excessive softening.
- Harvesting when market prices are high regardless of the stage of maturity of the commodity.
- Use of rough and/or unsanitary field containers.
- Harvesting during the hot hours of the day.

- Rough handling, dropping or throwing produce, fingernail punctures.
- Leaving long or sharp stems on harvested produce.
- Long exposure to direct sun after harvesting.
- Over-packing of field containers.

Whenever possible, growers plan their planting dates to match the period of higher market prices (table 5), but sometimes this means that produce maturity is not optimized for good quality. Any grower who can maximize his production to match the off-season (by using season extending technologies such as row covers, mulches, thinning, pruning, etc.) can earn a lot of extra profits. An example in the fluctuation in market value of tomatoes is as follows:

- Value during peak of season: 10,000 per box
- Value during dry season: 120,000 per box
- Value during off-season: 300,000 per box

Produce harvested too early is much more susceptible to diseases, water loss, and shrivel. Fruits harvested too early may never ripen, or may soften but lack flavor and aroma. Produce harvested too late can be tough (okra) or too soft (fruits) to handle without damage, and will have a much shorter shelf life than produce harvested at its proper maturity.

Table 5: Production Information for Selected Commodities

	Time of Planting		**Time of Harvesting**				
Crop	**North**	**South**	**North**	**South**	**Gestation Period (Days)**	**Low Price Period**	**High Price Period**
Mango	May/June		Mar./Apr.	Apr./June	3-4 years	Mar.–June	Sept.–Dec.
Papaya		April/May		Dec./Jan.	210		
Cassava	Mar./May	Mar./May	Begin in Mar./May	Begin in Mar./May	365	Aug.–Sept.	April
Yam	Dec./Jan.	Mar./Apr.	Aug./Sept. & Nov./Dec.	Jan./Feb.	240-360	Sept.–Oct.	April-May
Sweet Potato	May/June	Apr./May	Sept./Oct.	Aug./Sept.	90-120	Aug.–Sept.	Apr.–May

Source: Ministry of Food and Agriculture, Ghana, 2002

Harvesting schedules for pineapples are determined by the date from forcing, which is planned to correspond to desired shipping dates. The requested maturity standard by most buyers is 12 percent brix. Papayas on one farm were harvested "when they look the right color," but no color charts were provided to harvesters, and no measurements of SSC or internal color were made before packing.

Field containers in use for the domestic market included sacks, baskets and wooden crates, all known for their roughness on fresh produce. Baskets and sacks provide almost no protection

when stacked. Crates provide more protection, but are rough on the interior surfaces, causing abrasions during transport. These containers are difficult to keep clean and can spread disease from one batch of produce to another. When produce is "dumped" from field containers into transport containers, produce can be damaged by handlers who do not take care to reduce the height of drops.

Produce intended for export is sometimes packed in the field directly into fiberboard cartons. Field packing can greatly reduce handling steps, but whenever harvest workers field pack, they must be well trained to ensure that market specifications (for example: size, weight or color) are met for each and every package.

Plastic crates were in use for harvesting papayas on one farm we visited during the assessment. VEGPEAG members expressed interest in using plastic field crates. These crates are extremely sturdy and can be more easily cleaned. Plastic crates can also be useful for long-distance transport, especially if they are padded before filling.

Produce intended for local marketing is either collected at the farm gate by market ladies (who may pay for the produce when they next return to purchase again). Since there is no on-farm storage to speak of, growers must often accept whatever price is offered by the wholesale buyers at the farm gate if produce ready for marketing. On small farms, produce is sometimes carried by local grower/marketers to the retail market in baskets or sacks.

Curing

Some crops (roots, tubers and bulbs) must be cured before they are ready for the rigors of post-harvest handling. Uncured vegetables of these types lose weight much faster than cured produce and are much more susceptible to disease. VEGPEAG members indicated that they were aware that they needed education on the proper practices for curing sweet potatoes.

Packinghouse Operations

The following are typical problems found in packing operations developing countries. All were found in Ghana with respect to handling produce intended for the domestic market.

- Lack of proper sorting
- Lack of cleaning, washing, or sanitation.
- Rough handling.
- Improper trimming.
- Long delays without cooling.

- Lack of accepted and/or implemented quality grades or standards for commodities.
- Lack of quality inspection.

For produce intended for the export market, the lack of these packinghouse practices was much less of a problem. However, three major problems were observed:

- Inadequate chlorine in wash water.
- Misuse of hot water dips for pest management.
- Long delays without cooling.

These three handling problems contribute to shortened shelf life and increase susceptibility of produce to decay during handling. Chlorine is a very inexpensive chemical that can sanitize the surface of produce during washing and slow the spread of disease in packaged produce.

If hot water dips are in use, they must be used properly (at the correct temperature of a suitable period of time) to sanitize the produce surface without causing damage to the product. The only example of "pest management" hot water dip we observed was a 60 C for 30 seconds treatment, so short it is unlikely to be of much benefit. The fruit was then cooled by placing it in cool water (ambient temperature).

Cooling must be considered an integral part of the handling system if produce is intended for export. See the section on cooling below.

Exporters used a variety of quality control and inspection practices. Some grower associations have permanent quality control officers, while other exporters rely on quality checks at the destination market. One of the larger pineapple growers has brought in a consultant from Holland at a cost of $42,000 per year. Several E.U.-based supermarket chains send their own food safety inspectors to the farms, and each enforces their own specifications.

VEGPEAG members use a system where growers supply produce on a scheduled basis, and each package can be traced back to the grower (but not to any individual farm location) if there are any reported problems. Proper documentation of handling practices is becoming more important every year. Having the capability to check produce quality/maturity by using an objective or subjective measurement locally before shipping and being able to trace produce back to an individual field if a food safety problem arises are two important aspects of international marketing.

Packinghouse operation costs can sometimes be significantly lowered if exporters are willing and able to share facilities. Several times during our interviews the assessors were informed that cooperation was theoretically possible but highly improbable since "growers

appear to be too individualistic" and "everyone thinks they are in competition with everyone else." There are some collection centers in existence, (for maize and for yams) but none yet for fruits or vegetables.

Last year, in collaboration with Ghana's Export Council under the Poverty Alleviation program, the Food and Drugs Board provided training to handlers of non-traditional products, including fish, cashew nuts, and mangoes. The trainers noted that the trainees expected instant results and were not interested in the details of improved post-harvest technology. For example, they reported that the trainees (average age of fifty or older) were unwilling to believe that mangoes should be washed to remove latex (to prevent staining of the peel during handling).

Packaging

Some of the most common causes and sources of post-harvest problems that are related to packages and packaging includes the following, and all were found in Ghana during the assessment:

- Use of flimsy or rough packing containers.
- Lack of liners in rough baskets or wooden crates.
- Over-use of packing materials intended to cushion produce (causing interference with ventilation).
- Containers designed without adequate ventilation.
- Over-loading containers.
- Use of containers that are too large to provide adequate product protection.

When the product is destined for the local market, packaging consists mostly of sacks, wooden crates, and large baskets. Often the baskets are covered with a white cloth to protect the produce from dust. Simple improvements in the packages chosen for domestic marketing would have a positive impact on produce quality and shelf life.

Product prepared for the export market is typically packaged into cartons at the field. In some cases, the boxes were purchased and supplied to the producer by the importer. However, many other firms indicated that they purchased the boxes for themselves. They found that they could get a better quality package for a lower price if they imported the boxes instead of buying them locally. Most locally made packages cannot stand up to cooling and tend to collapse under high humidity conditions, although they perform satisfactorily for air shipments. VEGPEAG growers are importing packages from Finland, at a cost of $1.15 for a 2 kg net carton.

The type of cartons used is based on the importer's requirements, including dimensions, net weight, and labeling. The produce is sorted

and, typically, arranged in boxes by count. The majority of pineapple exporters are now using 12 kg cartons, and a standard pallet consists of 65 cartons.

Some of the yams sent to the seaport for export were wrapped in paper before packing into cartons. The use of too much paper in cartons can interfere with cooling during transport.

Some operations palletize the boxes before sending them to the air or sea port. However, both facilities offer re-stacking and palletization services for a nominal fee.

Cooling

Based on the assessment interviews and site visits, no producers were using a formal system for pre-cooling produce from the field. VEGPEAG members stated "to preserve quality we need the cold chain," especially since the journey to the ports for some of their crops can exceed nine hours in an insulated (un-refrigerated) trailer or via open load. Some fruit growers reported that they must harvest for a full day or even two days, in order to fill a truck-load for transport. The temperature stress on produce handled under these conditions is enormous.

The only examples of cooling witnessed or discussed during the assessment are:

- Papayas treated for export are placed in cool water following a very short hot water treatment.
- Pineapples and a few other fruits are shipped under refrigerated conditions as marine cargo, offering a cold environment to help maintain quality during transportation.

Storage

Some of the most common causes and sources of post-harvest problems that are related to storage include the following, and all were found in Ghana:

- General lack of storage facilities on-farm or at wholesale or retail markets.
- Lack of proper ventilation and cooling in existing on-farm facilities.
- Poor sanitation and inadequate management of temperature and relative humidity in larger scale storages.
- Over-loading of cold stores.
- Stacking produce too high for container strength.
- Mixing lots of produce with different temperature/RH requirements.
- Lack of regular inspections for pest problems, temperature/RH management.

Every farm visited during the assessment and most of the grower interviewed explained that they harvested the produce just-in-time (JIT) for transportation to the port, market, or for pick-up by a buyer. Therefore, cold storage is generally considered to be not needed. VEGPEAG members, however, explained how they currently have had to store a large quantity of sweet potatoes

in cold storage because they have had trouble finding adequate transport. They are paying the equivalent of five cents per kg per day for temporary storage. This is a good example of how JIT planning can be derailed by factors outside the control of the grower.

Two companies have their own small-scale cold storage facilities at Kotoka International airport. Blue Skies was using their marine container-style storage for holding fresh cut pineapple under refrigeration until shipping via air. The other storage is an insulated walk-in cooler located under the eaves of the airport cargo handling shed.

The Food and Drug Board recently surveyed storage warehouses (mostly storing frozen produce or medical supplies) and found many problems, including:

- Poor quality structures.
- Poor ventilation.
- Poor temperature management.
- Incompatible good stored together.
- Poor warehouse management practices.
- No documentation of pest management.

They concluded that their Environmental Health Officers need to be trained in food safety issues, specifically in GAP and HACCP practices.

Storage at the ocean port and airport is discussed further under the transportation section below.

Transportation

Some of the most common causes and sources of post-harvest problems that are related to transportation include the following, and all were found in Ghana:

- Over-loading vehicles.
- Use of bulk transport or poor quality packages leading to compression damage.
- Lack of adequate ventilation during transport.
- Lack of air suspensions on transport vehicles.
- Vehicles in poor condition, “rough shape,” not well maintained mechanically.
- Rough handling during loading.
- Lack of refrigerated transport for perishables.
- Transport delays.
- Poorly managed freight consolidation, lack of back-loads.
- Ethylene damage resulting from transporting mixed loads.

The majority of produce intended for the domestic market moves along roads via public transport or hired vehicles. Produce moving to the ports for export marketing moves by vehicles hired by the day or load, in leased vehicles or in some cases, in grower/marketers owned-and-operated vehicles. Railroads, lake routes and domestic airports exist, but none accounts for any measurable produce movement within Ghana.

Aside from international shipments, the Ministry of Roads and Infrastructure (MORI) reported that there is no domestic air transport for freight. Although there is some use of transportation via watercraft on the lake this method is not utilized for agricultural products. VEGPEAG growers told the assessors that recently it had taken one month to negotiate transport for a load on a river vessel.

Railroad

The rail system, though outdated and dilapidated, is still used to move some produce from Kumasi through Nkoko into Accra. The use of rail to bring produce into Accra is utilized mostly by the produce wholesalers, known locally as "market queens." Carrying large baskets of fresh fruits and vegetables with them onto the passenger cars, these marketers sell and buy produce at the various stops along the way to the market in Accra. The passenger fare is 10,000 cedis, and the fee charged for produce is based on the weight of the packages. The train of 8 to 10 coaches and cargo vans is scheduled to run once a day to and from Accra. However, at the time of this assessment, the train had been delayed for many days due to a derailment.

Maintenance of the railroad tracks is the responsibility of MORI, but the condition of the railroads has deteriorated over time. MORI personnel expressed interest in making improvements to the railroad in order to take some of the pressure off road transportation infrastructure, but the cost is likely to be prohibitive.

Roads

Despite the availability of railroad and water routes, road transport is the most readily accessible and most commonly utilized mode for shipping Ghanaian fresh produce. Road transport (via truck, bus, tro-tro, cart, or foot) is the most common method used to ship produce from the farms both to the local market and to the ports for export. (According to MORI, 94 percent of all freight is moved domestically by truck.) Although certainly more common, truck transport is not the only method used on the roads. Small villages outside Accra use public bus transportation in order to move large baskets of fresh produce to the market in Accra. And once the product is delivered by truck to the wholesale market, smaller quantities are then transported to other markets via hand cart and by foot.

However, truck transportation is most frequently used to move larger quantities of fresh produce to the local market and to the ports (air or sea) for export. If the shipment is destined for export, the farmer will lease a truck (unless he owns one) to deliver the product to the port. Hired trucks may be dirty or have inadequate shocks or over-inflated tires, all of which will contribute to produce damage during transport.

If the shipment is going to a local market, it is usually bought by a wholesaler or "broker" who supplies the transportation from the farm for the produce. There are cases where market ladies must wait for days before transport begins, since they must wait for a truck to collect a full load.

There does not appear to be a major problem with access to trucks and, though vehicle breakdown and the use of trucks in poor condition can be a problem, according to the persons interviewed during the assessment, the two main bottlenecks identified by Ghanaian shippers regarding domestic transportation are:

- Poor road conditions.
- Traffic and congestion on the roads.

The main highway into Accra is only two lanes, resulting in much traffic and congestion. One bad accident can cause hours of delays. MORI explained that, only 2.7 percent of the roads in Ghana are paved. Most of the roads in Ghana are "feeder roads" that connect small villages to the highway system. These feeder roads are not paved and are often impassable during rainy seasons. According to MORI, 58 percent of Ghana's road network is currently in "poor" or "very poor" condition.

VEGPEAG growers were described as scattered on small holdings, but they would like to invest together in a shared "cold van" which would run a regular route picking up produce from the farms. At present a hired truck must travel long distances between growers, each of whom may have a few cartons of produce to deliver. The vehicle is "always in a rush to meet the plane." They are also discussing setting up collection points or organizing growers in specific areas so transport could be more easily coordinated.

These problems, along with the lack of use of temperature controlled transportation methods combined with the use of insufficient packaging (see section on Packaging), commonly results with a less-than-desirable product arriving at the markets.

Recognizing the importance of maintaining the village feeder roads that farmers and other village enterprises use to get their product to the markets, MOFA and MORI combined efforts to develop the Village Infrastructure Project or "VIP." The goal of the project is to empower local districts to decide which roads should receive priority for maintenance, since only a few kilometers can be improved due to budget constraints. One farmer interviewed during the assessment pointed out that despite the development of this program, the road allowing the most direct trip to Accra from many of the farms in his region was not prioritized. Rather, a less convenient, longer route was re-graded. It is not certain whether or not this is a common oversight, since there was little feedback provided by the farmers interviewed on whether or not the VIP program was found to be effective or not. In any case, the budget for upgrades is quite small, with an average of only nine kilometers of roads per district scheduled for repairs per year.

Inter-Modal Transport

Refrigerated transportation is typically not used for moving any of Ghana's produce from the farms. For containerized export movements and for air shipments, much of the product is

delivered by truck and unloaded and palletized at the port before being loaded into air or sea containers for the international voyage.

The Ministry of Roads and Infrastructure (MORI) described the transportation system for moving freight in, out, and around Ghana as "intermodal." Air and marine transport are both used for international transportation, however, packaged produce is loaded onto open trucks or into insulated (non-refrigerated) container trucks and is unloaded from these vehicles at the ports. We observed no utilization of refrigerated trailers or marine containers at the farm level, and none in use for road transport of fresh produce (with the exception of bananas), and therefore not much traditionally defined "inter-modal" transport. The adoption of true inter-modal transport could be a useful step in Ghana's fresh produce handling for export, since loading refrigerated containers at the farm gate or packinghouse dock would reduce many of the problems associated with temperature management and transport delays.

Air transport

There is one international air facility in Ghana--Kotoka International Airport. There are three other domestic facilities: Kumasi Airport, Tamale Airport, Sunyani Airport. However, as mentioned above, there is very little freight moved around the country by air. Kotokoa International Airport has many different international airlines frequenting it, including: KLM, Swiss Air, Ghana Airways, Lufthansa. According to GCAA's operating statistics, there has been a constant increase in freight handled by Kotoka since 1991. For more information about the port, visit GCAA's website at http://www.gcaa.com.gh.

Fees for handling freight appeared to be reasonable ($500 maximum per load), and freight forwarding services were available at a nominal fee (50,000 to 120,000 cedis, depending on tonnage). Ghana's exporters realize that lower airline rates are available to those who can supply product more consistently and in larger volume, but most growers have yet to meet these desirable criteria. "Dedicated" cargo flights are privately arranged by exporters, and passenger planes carry more fresh produce than any other port in West Africa. At present there are four scheduled flights per day that carry fresh produce as cargo.

Kotoka International Airport does not yet have USDA inspection facilities and has no fumigation facilities. Estimated transport time to the United States from Ghana is 10 hours (compared to six hour flights to E.U countries).

The handling of cargo when it reaches Kotoka International Airport is managed exclusively by African Ground Handling Operations (AFGO). AFGO is a Ghana registered company, formed by a parent company called ICTC Investments Limited, with a combined shareholding of 50% by Gatwick Handling International (a British company based at Gatwick Airport) and 50% by Ferrum Nv (a Belgium Company based in Antwerp) which was contracted in 1994 by the Ghana Civil Aviation Authority (who manages Kotoka International Airport). When we visited the port, fresh produce cartons were

being unloaded from delivery vans in the asphalt parking lot in direct sun, while the cars of employees were parked under shade.

Some shipments of pineapples are stored by its owners at the airport in privately owned refrigerated storage units. However, most shipments are held in general storage in a large shed without refrigeration after arrival and customs inspection until the airplane is ready for loading. Ventilation inside the shed was adequate, but temperatures were still quite high (we measured air temperatures from 86 to 90 F). Most shipments arrived less than 24 hours prior to the scheduled departure, but some shipments arrive as much as two days in advance. Mixed loads are common, and one concern is the tendency of pineapples to absorb odors from chili peppers.

Ethylene damage is another concern during delays in shipping mixed loads. Ethylene gas given off by ripening papayas can cause damage to okra (loss of green color), eggplant (separation of the calyx), chilies (accelerated senescence) and green beans (yellowing).

Despite the availability of covered storage, at the time of the site visit during this assessment, pallets of produce were left out on the tarmac under the hot sun in the afternoon while waiting to be loaded onto the plane due in the evening. The Kotoka Airport has plans to expand its cargo handling facilities and build an improved and larger warehouse that will allow for temperature-controlled storage.

Marine Transport

There are two main ports in Ghana—Tema and Takoradi. Both ports lie in Southern Ghana at the Gulf of Ghana on the Atlantic Ocean. Tema is the main ocean container facility in Ghana, handling non-traditional items, such as fresh produce. There are a variety of large shipping lines transiting Tema, including, MaerskSealand, Torm, P&O Nedlloyd; however the total number is relatively few compared with ports with more trade flow, such as Asia. Ghana Ports and Harbors Authority is working with a Dutch company to dredge a deeper berth in order to allow larger containerships into the

port. Tema does not have a reputation for terribly long wait times or congestion, unlike other ports in Western Africa. However, during the assessment, the Authority commented that they do have comparatively slow per container lifts and drops.

After reaching the Port of Tema, all "non-traditional" export cargo (including fresh produce and grocery items) is stored in one facility, a covered shed. No temperature-controlled storage is available at the port, and temperatures in the shed are known to reach 36 to 39 C. (We measured the morning temperature at 34 C during our assessment.) Shipments arrive typically within one to three days before the departure date. Yams are consolidated from many shippers at this point, and palletized.

At the time we visited the port, a shipment of pineapples that had arrived the day before was waiting for a ship due the next day. We were told that this was an example of the 48 hours that was the optimum scheduled delay before loading. Many of the produce shipments, bulk and containerized, are shipped overseas under a temperature controlled system in bulk holds of the shipping vessels. Although bulk shipping is more frequently utilized due to its lower costs (e.g., SPEG negotiates for a large grower base), containerized refrigerated shipments of fresh produce, including pineapple and okra, are also possible. A Maersk-SeaLand container ship arrives once a week (on Fridays). Bananas are currently the only product to arrive containerized from the farms. The manager of the export shed explained that he wished more of the produce could be handled like bananas.

Cocoa beans are shipped in massive quantity from the Port of Tema, and the many handling operations involved are handled smoothly and efficiently. As an example of what can be accomplished when there are major profits to be made, cocoa is delivered (600 bags per truck), quality checked for moisture content, bean count/100 g and defects, warehoused, fumigated, quality checked (to confirm initial tests), undergoes plant quarantine inspection, and is rechecked for quality before being loaded (in bags or bulk) into containers that have been inspected, sprayed and lined, fogged, sealed and loaded onto ships. Any bag that does not pass inspection is returned to the supplier for "re-standardization," a process which costs so much that suppliers are sure to deliver only high quality product.

The Port at Tema is undergoing dredging this year to a depth of 11.5 meters in order to better accept the container shipping vessels that require a deeper harbor. The quay is also being extended so more vessels can be loaded and/or unloaded at the same time.

For more information on transportation and trade with the United States. (See Appendix G).

Destination handling at domestic markets

Some of the most common causes and sources of post-harvest problems that are related to destination marketing include the following, and all were found in Ghana:

- Rough handling during unloading.
- Lack of re-sorting, poor sanitation, improper disposal of culls.
- Lack of protection from direct sun during direct marketing.
- Open-air horticultural markets exposed to sun, wind, dust and rain.

Product arrives at the wholesale markets in Accra daily by bus, train, or truck. Vendors arrive as early as 4 a.m. to purchase product as it arrives from the fields. Once the fresh produce arrives at the wholesale market, it is quickly sold to retail vendors. Sometimes the produce is sold along with the packaging. In other instances, once the product arrives at the market, buyers bring their own baskets or bags in which to carry the smaller quantities they purchase and in which to display their products. Produce is then sorted and displayed in baskets, on cloth laid out on the road, or openly on tables.

There is no cold storage in the open markets, so produce with a limited shelf life begins to wilt and or decay quite rapidly. Vendors who have secured a rented space at the inside the market may have some sort of shade over their stands, but otherwise the product is completely exposed to sunlight, insects, car pollution, and air temperature (normally warm in the mornings and hot in the afternoons).

Using simple methods for shading and for refreshing produce, such as water sprays or the use of ice, could reduce losses and improve profits for retail vendors in Ghana.

Agro-processing

The status and potential of commercial scale agro-processing in Ghana was beyond the scope of this assessment, but the topic always arises when people begin thinking about how to deal with high levels of post-harvest food losses, periodic gluts of perishable produce and increasing consumer demand for food. Unfortunately, developing food processing factories that depend on the low prices of raw materials available during peak production periods has been demonstrated worldwide as a sure way to go bankrupt. Since most processing operations are capital intensive, and require investments in high tech equipment, supplies of raw materials must also be consistent year-round for most processing operations to show a profit. Problems with plants sitting idle, with producers breaking contracts whenever local market prices rise, and with meeting quality specifications are common in the food processing industry in developing countries.

There was some interest expressed by stakeholders in simple agro-processing practices, especially in learning more about drying technologies. Ghana's government has recently given high priority to the development of non-traditional exports, and this includes processed food products. VEGPEAG members expressed interest in learning how to dry red chilies and other vegetable crops. In this case, making small investments in simple technologies can assist grower/marketers to take advantage of peak periods of production to divert produce from the local market and add value to produce that currently may have little or none. Storage, transport and handling of dried or canned produce is much less difficult for marketers than is dealing with fresh produce, and shelf life of the processed product is much longer.

Secondary Findings

Market Research

Market research is one of the many important keys to entering any new market. This research needs to be completed in order that wise decisions can be made as to which markets should be an area of focus. Market information, such as foreign competitors, domestic tastes and preferences, and transportation costs, should be determined before spending time and efforts on one particular commodity or market. Although the demand for information is great, there seems to be very little market research completed in Ghana on the topic of exporting fresh produce to the United States.

At every interview with produce exporters, there was a request for market research regarding the competitiveness of their product(s) in the U.S. market. Market Research includes collecting information on:

- Product
- Price
- Promotion
- Packaging
- Policies

Although MoFA should be the main source for this information since one of their goals is to promote Ghanaian product, the trade associations should also assist their members in providing this type of data. However, none of the organizations appears to have completed this type of research. Further, the producers interested in exporting should be made aware of the information easily accessible via the Internet and international assistance organizations, such as USAID (AMEX, Inc., for example). The U.S Agricultural Embassy Representative present during the meetings encouraged the use of the Ghanaian Ambassador stationed in the United States as a resource, as well. He also shared with them some marketing information gathering opportunities available in the United States, such as the Produce Marketing Association's (PMA) annual convention and other trade shows.

Governmental policies can have a major effect on product cost (due to effects on costs of production, handling and packaging) and overall profitability of produce marketing. Policies that stakeholders in Ghana mentioned included:

- Slow refunds for VAT.
- Levies on imported packages and supplies.
- The rough shape of existing roads.
- The lack of good roads in the Afram Plains area and from the interior to the ports.
- The gradual re-imposition of export fees (Export Development Fund fee, inspections fees etc.), high labor fees charged by port authorities for mandatory handling services.

Many international produce firms and marketing associations are targeting the U.S. market with fresh, exotic produce. These commodities include lychees, baby pineapples, cactus pears, fresh chili peppers and papaya fruits. Guatemalan exporters (Frutesca, for example) are focusing on baby vegetables, such as edible pod peas, baby squash, baby carrots, and specialty eggplant. Katope International, a Paris-based fresh produce marketing group, is sourcing product from Latin America, Senegal, Cote d'Ivoire, Madagascar, Zimbabwe, and South Africa (AmericaFruit (Feb/March 2002). Freida's Inc., based in California, markets and distributes over 500 exotic products, including herbs, vegetables, and fresh and dried fruits grown by specialist growers in Latin America, Asia, the Middle east, New Zealand and the United States. If Ghana's grower/exporters want to get in on this growing market, there may be a niche for "Produce from Africa," especially in certain urban U.S. markets, but much market research needs to be done before jumping on the band-wagon. A study tour of U.S. markets may be a good investment for Ghana's exporters.

Ghana's grower associations are slowly making moves in the direction of international marketing. The VEGPEAG association (with 244 registered members) is developing a product logo, and SPEG (representing 30 pineapple shippers) is joining with HAG to reduce administrative costs. This is a positive achievement, since buyers worldwide always prefer dealing with a single entity representing many growers. In an effort to assist with these cooperative marketing undertakings, we have gathered selected resources for collecting market information:

- Import Data
- Comparative Shipping Costs
- Resources for Marketing Opportunities

Extensive market research is also required to identify potential processed food products that may be viable business opportunities for Ghana's grower/exporters. Some possibilities include dried fruits (mangoes, papaya) and dried cassava products.

Grades and Standards

Interviews with the Food and Drug Board and the Ghana Standards Board involved discussion of the development of local standards for fruit and vegetable marketing. Most existing standards used in Ghana are for processed products and do not involve grading. Products either pass or fail

a set minimum mandatory standard and are intended to protect the health and welfare of consumers.

USDA's Agricultural Marketing Service had already provided some training to six Ghanaians in grades and standards for marketing (through the non-governmental organization TechnoServe).

United States grades and standards for fresh and processed produce are well-known, in use globally, and are available at no cost to users of the internet. Hundreds of commodities are covered in the guidelines, and we have provided a few examples here via links to downloaded pdf files. See Appendix D. For additional commodities visit the Fruit and Vegetable Program website at: http://www.ams.usda.gov/fv/.

Complicated grades for domestic produce are probably not desirable at this point, since retailers sort their produce voluntarily and charge slightly higher prices for better quality produce. Classifications are based on cultural preferences.

Additional aspects of grades and standards training include:

- Specifications per market requirements
- Documentation
- Inspection
- Quality Control
- Labeling requirements

Chinese vegetable exporters have recently made big progress on the quality front, and Chinese exports to Hong Kong, European, and Japanese markets are expected to increase quickly over the next few years.

Food Safety--EUREP/GAP and HACCP

It may soon be impossible to export produce without documenting its safe handling from the farm to the market. Key concepts are the implementation of GAP on the farm, in the packinghouse and during transport of all fresh produce, and HACCP (Hazard Analysis Critical Control Points) to document the safe handling of farm chemicals, pesticides, packaging materials, etc., especially for processed or fresh-cut produce.

There is a deadline for food safety looming for fresh products intended for market in Europe. Ghana's growers have until 2003 to meet specifications for hygiene and quality. Most packinghouses will require new water systems and sanitation practices. Blue Skies, a fresh-cut pineapple exporter, is the only company to be certified in Ghana to date. AMEX International is active in Ghana in this area and provides training in ISO 9000, HACCP, and EUREP GAP (see next paragraph) certification requirements.

New standards for fruits and vegetables marketed in Europe are being promoted as a means of boosting consumer confidence in the fresh produce market. "EUREP (Euro Retailer Produce Working Group), represents leading European food retailers and uses GAP (Good Agricultural Practice) as a framework for verification. It is designed specifically for businesses in the fresh

produce supply chain. It offers a means of incorporating Integrated Crop Management (ICM) and Integrated Pest Management (IPM) practices within the framework of commercial agricultural production. The EUREP GAP Protocol describes essential elements and develops best practice for global production of fresh produce and horticultural products. It demonstrates to customers a company's commitment and ability to produce safe and clean food, under an exhaustive system (HACCP) verified by an internationally recognized independent third party." (SGS Société Générale de Surveillance brochure, 2002)

As a regional Secretariat for EUREP GAP, EUREPGAP*Africa* was founded on March 22, 2002. EUREPGAP*Africa* will be run by QC-Fresh, an experienced organization in the fresh produce sector in Southern Africa. The Eurep GAP Standard is available from EHI at: http://www.eurep.org. EHI is the accreditation body for EUREP GAP. Its website contains information about EHI and EUREP: http://www.ehi.org.

EUREP GAP steps to certification are:

1. Proposal/application for certification.
2. Pre-assessment audit (optional).
3. Certification audit.
4. Registration/ongoing surveillance.

Guidelines for growers have been published by various sources. A copy at no cost can be obtained from Cornell University's Good Agricultural Practices Program. Send an e-mail to "eab38@cornell.edu" to request a copy.

Appendix F contains a link to the U.S. Food and Agricultural Import Regulations and Standards report from the Foreign Agricultural Service. The FAIRS report includes information on the U.S. import regulations for food labeling, pesticide contaminants, and food additive regulations.

Cost/Benefit Analyses

Knowledge of local prices for post-harvest supplies and the value of the commodity in various markets makes it possible for handlers to properly identify cost effective changes. Following advice because it is technically useful does not guarantee that the results will lead to improved profitability. In Ghana, where interest rates can run very high (up to 45 percent per annum during the assessment), calculating the expected return on any short term investment becomes critical before deciding to make any changes.

The worksheet below can be used to calculate costs and expected benefits in Ghana.

Worksheet: Comparison of Costs and Benefits

1) Costs

Does one practice cost more than the other for materials, power, equipment, labor, storage, transport, marketing, etc.? Calculate based on expected yield, hourly labor costs, expected and volumes to be handled.

	Current practice	New practice
Cost of equipment		
Cost of supplies		
Cost of labor		
Cost of power		
Other		
Total direct costs		

2) Benefits
Base upon expected yield, quality, amount of produce at various grades, predicted market prices. Use either wholesale or retail prices or a combination if you will sell both ways.

1. Expected sales (wholesale)

	Current practice	New practice
Highest grade		
Second grade		
Lowest grade		
Subtotal sales (wholesale)		

2. Expected sales (retail)

	Current practice	New practice
Highest grade		
Second grade		
Lowest grade		
Subtotal sales (retail)		
3. **Total Expected Sales**		

3) Comparative Advantage

	Current practice	New practice
Calculate: (Total Sales - Total direct Costs)		
Which practice is most profitable?		

4) Recovery of Invested Capital (ROIC)
How long will it take to pay for your investment in the new practice or technology?

1. Actual capital outlay for new practice = _____
(Difference in total direct costs for new equipment, facilities, power costs, supplies, labor requirements when compared to current practice).

2. Interest rate (if capital is borrowed) = _____% per annum; or _____% per month
cost of capital at three months = _____;
cost of capital at six months = _____

3. Change in sales using the new practice = _____per month
(Subtract total expected sales using the current practice from total expected sales using the new practice; divide the difference by number of months of sales).

4. Calculate ROIC in months to pay for investment:
(Actual capital outlay + any interest paid) **/ Change in Sales** per month = Months to pay for investment.

(_____ + _____) / _____ per month = _____ Months

(Source: Kitinoja, L. (1999). Costs and Benefits of Fresh Handling Practices Perishables Handling Quarterly, Special Issue: Costs and Benefits of Post-harvest Technologies, No. 97: 7-13)

Pest Management Issues
For produce intended for export, meeting phytosanitary requirements and avoiding restrictions and quarantines are an important component for ensuring marketability upon arrival at the destination port. APHIS provides clear guidelines for exporters: http://www.aphis.usda.gov/ppq/manuals/online_manuals.html. For information about products permitted by APHIS for import into the United States from Ghana, see Appendix F.

USDA has provided training for Ghana's professionals in pest risk analysis and phytosanitary standards.

Growing in importance during these past years is the concept of organic agriculture. Demand for organically grown produce in the United States in on the rise due to concern with health issues. Many countries are launching new organic commodities and forming trade organizations that are targeting the U.S. market, including these recent examples from AmericaFruit magazine, 2000-2001:

- Chile: Bios Organic
- Canada: Pro-Organic Marketing
- U.S. based companies using suppliers from Latin America and Europe: includes organic growers in Mexico (10,000 plus), Italy (40,000) and Austria (20,000).

(Source: www.americafruit.com)

The USDA has established new guidelines to assist growers who want to become certified to sell their produce in the emerging organic sector of the fresh produce market. For more information

about organic labeling, visit USDA's National Organic Program website at: www.ams.usda.gov/nop.

Market Information Systems

Obtaining knowledge on an on-going basis is the key to developing market information systems. Key information for exporters includes:

- Market prices.
- Links to potential buyers.
- Strengthening produce marketing associations.

Some market information can be obtained directly via the use of brokers who have established contacts (and contracts) in intended markets. For exporters new to the fresh produce trade, linking up with a good broker can be an excellent opportunity to gain experience.

Many of the stakeholders we interviewed suggested that Ghana's grower/exporter associations need strengthening in order to prepare to play a more active role in export development. The members of the associations we visited (SPEG, HAG and VEGPEAG) were familiar with certain practices that could improve profits (shared inputs costs, shared transport, assembly points for produce collection) but were viewed as most stakeholders as "not very effective as yet." In general, we were told by observers that Ghanaians often have trouble collaborating with one another.

Training Needs in Ghana

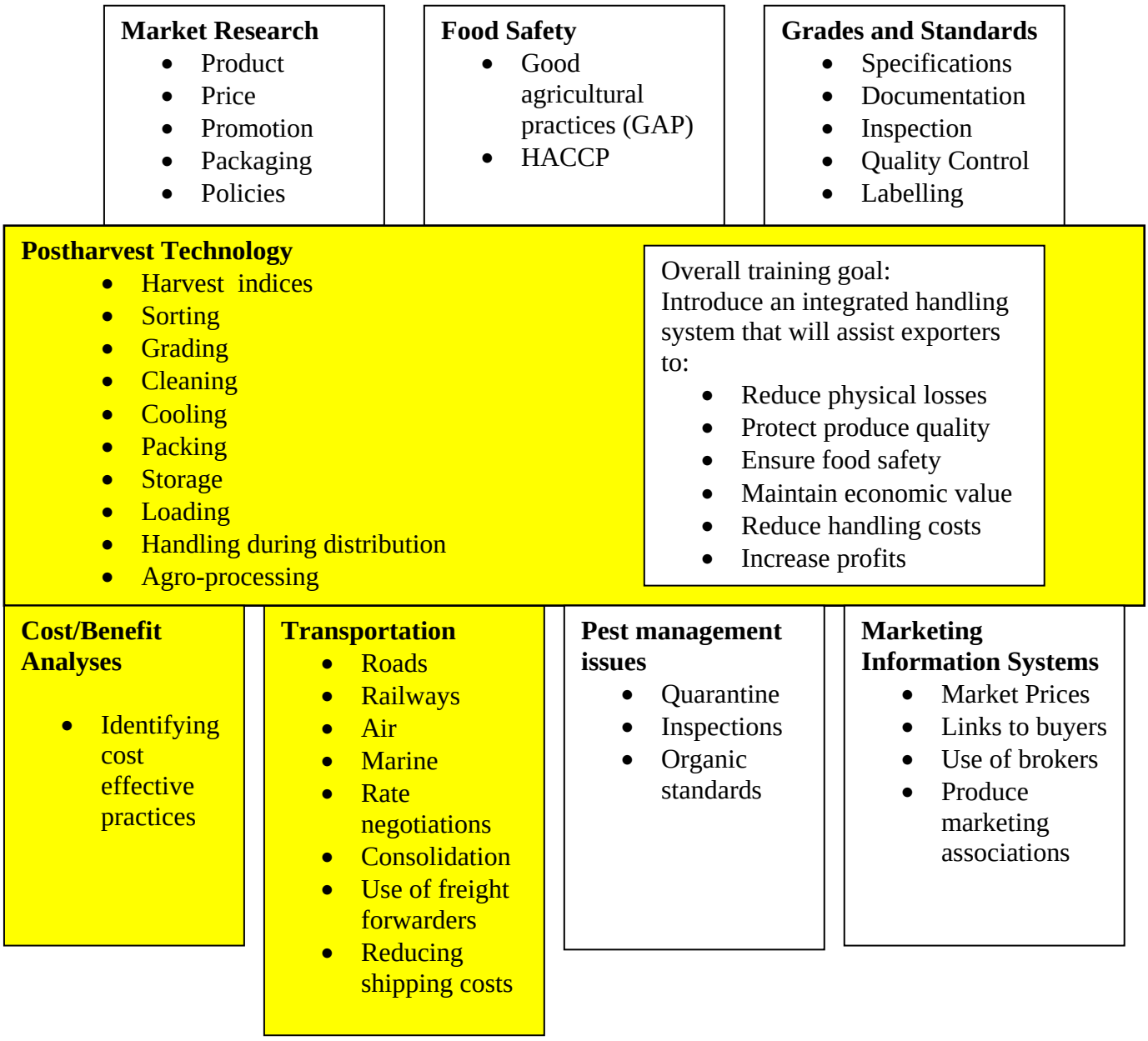
Overview

Figure 1b illustrates the relationship between all these topic areas, each of which must be addressed before Ghana's growers/exporters are fully prepared for meeting the challenges of exporting fresh produce in any large volume to the United States or any other country. Only a few topics can be addressed in the proposed training program. The priority topic areas are illustrated in color within the figure. It is recommended that CCARD identify several MoFA subject matter specialists who can take the lead and become specialists in the field of post-harvest handling and transportation systems for fresh produce.

The remaining topic areas must be addressed by CCARD in a systematic way to ensure that grower/exporters are not left with only a few pieces of the fresh produce marketing puzzle. Only in this way will Ghana's exporters be able to successfully develop new commodities and increase volumes of those products now being exported.

Figure 1b: Overview of Training Needs

Post-Harvest Handling And Transportation Training Needs For Fruit And Vegetable Exporters From Ghana



Training Priorities
Three topic areas emerged as key problems and the source of bottlenecks and high costs during the movement of produce from farm to market or port in Ghana:

- Preparation for market.
- Cooling practices.
- Transportation.

These three topic areas are closely related to one another, and a study of one will reinforce the others. The overall training goal is to introduce an integrated post-harvest handling system that will assist exporters to:

- Reduce physical losses.
- Protect produce quality.
- Ensure food safety.
- Maintain economic value.
- Reduce handling costs.
- Increase profits.

Preparation for market includes harvest, packinghouse operations, pest management, food safety, and packaging. Harvest indices can available for most commodities and assist growers to identify the exact stage of maturity that will result in the longest shelf life, natural pest resistance, and good eating quality. Improved packages, simple sorting practices, and proper pest management will further ensure the highest possible produce quality and safety with only small increases in handling costs. Certain products are much easier to handle than others, so a range of produce types will be covered.

Cooling practices were nearly entirely absent in Ghana, even regarding the basics of removing field heat and protecting produce from heat gain during handling.

Based upon the response to questions about cooling, Ghana's produce exporters do not believe that spending money on cooling will be a profitable exercise for them. But cost savings arise when handling (packing, loading, road transport, transfer to marine or cargo airplanes at the ports) does not go as planned.

In Ghana and in many developing countries JIT-planned deliveries are often quite slow to arrive and may not be on schedule:

- Trucks can be delayed by bad weather, poor road conditions, traffic accidents, etc. from arriving on time at the farm gate to pick up produce.
- Laborers (harvesters, packers, loaders) can be slower than expected due to bad weather, delays in receiving packing materials, making up cartons, pallets, etc., leading to delays in loading vehicles.
- Loaded vehicles may need to make several stops at different farms, compounding delays.
- Loaded vehicles can be delayed by bad weather, poor roads, traffic accidents, etc., from arriving at the port.
- Produce waits in vehicles parked in direct sun at the port when unloading schedules are not matched with time of delivery.
- Produce may arrive faster than port workers can handle deliveries, unloading and palletization.
- Customs documentation may delay the movement of palleted produce from unsheltered areas of the port into covered areas.
- Produce waits for hours or even days in some cases of marine transport under ambient conditions (at air temperatures from 80 to 95 F in Ghana) at the ports until cargo planes or ships are scheduled to arrive for loading.
- Palleted produce can sit in the afternoon sun for hours awaiting final loading if planes are delayed in arrival (flights are usually scheduled to depart in the evenings).

Given these conditions for handling fresh produce, the results of basic pre-cooling and refrigerated shipping practices in protecting quality, extending shelf life and reducing the rate of weight loss are likely to return more than is invested. Even without a complete cold chain there is much the small-scale exporter can do to reduce the temperature of the produce being handled for export. If Ghana intends to compete with other fresh produce marketers around the world, pre-cooling and refrigerated transport are important components of the task of providing a quality product.

Transport of horticultural commodities includes the practices of proper loading/unloading, stacking, management of transport scheduling, consolidation, handling mixed loads, and strategies for reducing transport costs.

Until the feeder roads can be greatly improved, it is imperative that shippers protect produce as best as possible and with the facilities available to them. Therefore, based on the information gained during the assessment, an important part of improved transportation is better preparation for marketing. This includes simple improvements in packaging and handling since Ghana's handlers must deal with unpaved feeder roads, congestion, accidents, and without temperature-controlled vehicles or

facilities. Further, training on reducing the costs of shipping overseas by container (Appendix G) is also recommended in a Module on Transportation.

These three topic areas will be developed into training modules consisting of written, visual (slides and videos), and demonstration materials that will be presented as a training of trainers program. See Draft of the Training Schedule.

Commodities

The following commodities, as identified by MoFA and throughout the assessment, were the focus of the assessment and will be the focus of the proposed training. Pineapples and eggplants are currently being shipped to the United States from Ghana. The commodities listed below are currently being exported from Ghana to the European community:

- Pineapple
- Papaya
- Mangoes
- Yams
- Chilies
- Sweet potato
- Eggplant
- Okra

A few other commodities will also be covered during the proposed training, since they are either similar physiologically to those listed above or may be commodities suitable for future export, based upon the market activities by other supplier countries. These and any other potential product require systematic exploration and market research studies by personnel in Ghana (affiliated with MoFA or CCARD) before any recommendations are made to growers.

- Ginger
- Avocado
- Green beans
- Watermelon

Domestic Versus Export Handling

The issues regarding improved post-harvest handling and transportation practices so far in this report have been addressed from the perspective of what needs to be done if Ghana's growers intend to export produce to the United States and other developed markets, but training in post-harvest handling is also important for small-scale local growers and marketers.

There are some very simple, inexpensive post-harvest practices that can be demonstrated to local handlers who sell on the domestic market and can assist them to reduce produce losses and maintain quality and food safety during handling. The training manual *Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops* (Kitinoja and Kader, 1995) is currently being updated and will be reprinted for the proposed training program in Ghana. It provides about 200 pages of illustrated handling practices from harvest, curing, packing, pest management and cooling, to temporary storage and transport suggestions for modifying current practices, as well as many resources for more information.

Domestic marketers handle many types of fresh produce, including some delicate commodities such as tomatoes, okra, and leafy greens. They can benefit directly from the many ideas provided in the manual and training program.

Cost/Benefit Analyses

An important aspect of selecting post-harvest handling and transportation practices that will be most valuable and cost effective for Ghana's handlers involves calculating costs and expected benefits based upon local prices for supplies. The data required to perform these calculations is being collected by personnel at MoFA and the U.S. Embassy. We expect to have the data before the training is offered in Ghana, and each module will offer only those practices that we can demonstrate to be cost effective for Ghana's handlers.

Certain costs and prices are fairly stable according to the Crop Services division of the MoFA and will be used in the calculations:

- Interest rate: 45% per annum
- Labor cost on farm: 7000 cedis per day
- Cost of baskets for carrying produce: 1000 to 1500 cedis per basket
- Cost of improved seeds for eggplant (1 acre): 36 packets at 2000 cedi each: 72,000 cedis
- Cost of improved seeds for chili pepper (1 acre): 50 packets at 1500 cedi each: 75,000 cedis
- Sacks (used for two seasons): 5000 cedis each per season

Average domestic market prices for fresh produce in March in Accra (published weekly in the Business and Financial Times):

Commodity (March)	**Measurement**	**Wholesale price (cedis)**	**Retail price (cedis)**
Pineapple	Avg size each	1,000	1,800
Watermelon	Big size each	15,000	20,000
Carrot	Avg size each	800	1,000
Oranges	Avg basket	10,000	15,000
Okra	Avg basket	60,000	80,500
Tomatoes	Big basket	50,000	60,000
Yam	100 tubers	140,000	150,000
Cassava	91 kg bag	580,000	590,000
Plantain	Avg size bunch	16,000	17,000

Info supplied by MoFA

Commodity (January)			**(sold per kg)**
Pineapples	100 pieces	111,000	1,250 each
Eggplant	Big basket (57 kg)	54,000	2,850 per kg
Chili pepper	30 kg basket	78,000	10,000 per kg

Just as a simple example, according to the price data available for pineapples and chili peppers, a handler would have more options for making improvements and potential profits when handling

chilies (a 30 kg basket purchased wholesale for 78,000 cedis has a potential selling price of 300,000 cedis) when compared to pineapples (100 pieces purchased for 111,000 cedis would resell retail for only 125,000 cedis).

Costs for the following items were requested from personnel at MoFA:

Item	Description		Cost in cedis
Plastic crates--	Large size Medium size		45,000 40,000
Port-a-cooler (rental cost per hour) (tel: 663085 Afrodan Ltd. Accra)	Large Medium Small		450,000 350,000 250,000
fiber-board cartons yams (25 kg size)	RSC Air Telescope		12,262.50 15,187.50
fiber-board cartons (chillies, okra)	5-7 kg size		5,400
fiber-board cartons (pineapple)	Large Small		10,546 9,280
electricity rate	(per kWHour)		
cost of a generator P = Petrol D = Diesel	**Type**	**Company A**	**Company B**
	5 kw size	15,000,000(P)	7,200,000 (P)
	6 kw (kva) size		13,800,000 (P)
	10 kw (kva) size	56,000,000 (D)	37,000,000 (P)
	10 kw (kva) size		43,000,000 (D)
wooden pallet standard size small size (for Europe)			
ice	25kg block		10,000

We will be using these data to determine which of the many potential postharvest technologies may result in profitable change in Ghana. In order to complete the cost/benefit analyses, we must also have a good idea of expected market prices for commodities over the harvest period. Ideally we should have information on local market prices (wholesale and retail), and export prices (wholesale).

Shipping Costs

One of the barriers to trade with the United States is the cost of international transportation. A refrigerated shipment between Ghana and the United States will range from $3,500-$5,000 or more, whereas a similar shipment between the United States and Ghana's chief competition for tropical produce, Latin America, can ship a refrigerated container of produce for as little as $1,500. Appendix G provides examples and comparisons of shipping costs for imports of pineapples, papayas, and eggplants into the United States from various countries.

There are many factors influencing the cost of ocean shipping, including frequency of voyages, competitiveness (the number of carriers in trade lane), balance of trade, and port efficiency.

Until two-way trade becomes more frequent between these two countries, ocean shipping costs will probably remain high, especially for high-valued, fresh produce which requires special equipment and handling; however, there are ways a shipper can reduce his costs and become more competitive using transport intermediaries, by negotiating contracts, and forming cooperative shipping associations. How to take advantage of these opportunities will be discussed in the proposed training discussed below.

Training Proposal

Recommended Training Participants
Trainees should have a solid background in horticulture, either as commercial grower/exporters or as trained professionals in the field (extension subject matter specialists, private consultants, or private horticultural industry company employees). Trainees should be in a position, due to their current job responsibilities, to be able to pass on their training by participating as instructors in future programs on post-harvest handling/transportation practices.

The Chief of Party and technical staff at AMEX International in Accra are assisting us in identifying appropriate candidates for training. It is recommended that training be provided for a nominal fee, to ensure that trainees are more likely to utilize their training as future trainers in post-harvest handling and transportation.

Proposed Dates and Location for Training Program
Since the Greater Accra and Central coastal regions have received the most attention in past development efforts in Ghana, we propose to hold the training in the Ashanti region during early September 2002. Growers and extension personnel from the Brong Ahafo and Ashanti regions could more easily attend a training held in or near Kumasi, and the instructors of the workshop could more easily visit the farming regions where Ghana's growers expect to launch major export production activities in the near future. For efforts to be successful, produce from the Afram Plain must be able to move more quickly, gently, and consistently to the air and sea ports. Grower/exporters from the coastal areas can also be invited to attend the workshop, since the practices that will be discussed will be useful throughout the country for protecting fresh produce from losses and damage during transport, especially during any period of inclement weather or during unexpected delays.

Draft of the Training Schedule Outline

Post-harvest Handling and Transportation Training the Trainers Workshop/CCARD Ghana

Module 1: Harvesting and Preparation of Fruits and Vegetables for Market
Objectives: To provide hands-on learning activities, demonstrations, audio-visual and written materials and discussions on post-harvest handling practices related to improved quality, food safety, reduced physical losses, higher exportable yield and market value.

Topics:
Domestic marketing in Ghana versus export requirements for key commodities
- Grades and standards
- Phytosanitary requirements
- Causes and sources of post-harvest problems
- Costs and benefits of using improved handling practices

A. Fruits (papaya, pineapple, avocado, watermelon)
- Harvest indices (maturity and quality)
- Harvesting tools and practices
- Field containers
- Washing, cleaning
- Trimming
- Waxing
- Sorting/sizing/grading
- Pest management
- Packing practices
- Packages and packaging materials
- Food safety (Good Agricultural Practices)

B. Immature Fruit-Vegetables (chilies, eggplant, okra, green beans)
- Harvest indices (maturity and quality)
- Harvesting tools and practices
- Field containers
- Washing, cleaning
- Trimming
- Waxing
- Sorting/sizing/grading
- Pest management
- Packing practices
- Packages and packaging materials
- Food safety (Good Agricultural Practices)

C. Tropical root and tuber crops (yams, sweet potatoes, ginger)
- Harvest indices (maturity and quality)
- Harvesting tools and practices
- Field containers
- Curing

- Washing, cleaning
- Trimming
- Waxing
- Sorting/sizing/grading
- Pest management
- Packing practices
- Packages and packaging materials
- Food safety (Good Agricultural Practices–GAP)

Tools and equipment required for demonstrations: sample produce at various stages of maturity, size, grade; hand clippers, cutting knives, color charts, refractometer, pressure tester, plastic field containers, straw and canvas for curing, chlorine bleach, grading charts, sizing rings, ruler, assortment of packages and packaging liners, trays, etc.

Module 2: Cooling Practices and Relative Humidity Management for Fresh Produce
Objectives: To provide hands-on instruction, audio-visual and written materials, and discussions and demonstrations on the importance of cooling and relative humidity management for protecting produce quality, shelf life and market value. Instruction will include: illustrations and demonstrations of the effects of temperature on shelf life, water loss and decay rates, and an introduction to the use of simple, low cost cooling practices that can be used to cool produce to 15 C before packing and to protect produce from heat gain during shipping.

Topics:
- Field heat for key commodities
- Heat of respiration, Q10 effect
- Effect of temperature on rate of decay
- Effect of temperature on rate of water/weight loss
- Effect of temperature on rate of ripening, senescence
- Effect of Relative Humidity on rate of water loss
- Recommended handling Temperatures and RH for key commodities
- Problems with "just-in-time" handling without cooling
- The basics of pre-cooling fresh produce
    - Providing shade
    - Evaporative cooling
    - Small-scale hydro-cooling
    - Portable forced-air coolers
    - Cooling during transport
    - Avoiding chilling injury
    - Avoiding water condensation
- Minimizing rough handling
- Minimizing delays and re-warming during handling and transport
- Calculating the costs and benefits of cooling in Ghana.

Tools and equipment required for demonstrations: samples of produce held for 3 days into controlled temperatures (0C, 10C, 20C) and under ambient conditions (27 to 32C). Shade cloth,

wet burlap, demo parts and illustrations for showing how to contract small-scale coolers (evap cooler, hydro-cooler, F.A. cooler, USDA porta-cooler), gel packs, pallet covers.

Module 3: Improving the Transportation of Fruits and Vegetables in Ghana
Objectives: To provide hands-on instruction, audio-visual and written materials and discussions and demonstrations on the importance of proper handling during loading/unloading and shipping, introduction to management practices that will protect produce quality, prevent damage, extend shelf life and reduce shipping costs.

Topics:
- The importance of packages and packaging materials
- Palletization of cartons (how and why)
- Reducing transport damage (air suspensions, grading roads, proper ventilation of the load.
- Loading vehicles: worker safety, protection of produce.
    - Road (open loads)
    - Refrigerated trailers
    - Marine containers
    - Marine cargo holds
    - Air containers
- Handling mixed loads (odor, ethylene and temperature compatibilities)
- Minimizing rough handling
- Management of transportation of produce for export
    - Planning/scheduling
    - Consolidation of loads
    - Buying or leasing vehicles
    - Freight forwarding
    - Sanitation and inspection
    - Maintenance of transport vehicles
- Reducing shipping costs
- The future of produce transport in Ghana
    - Refrigerated road transport vehicles
    - Inter-modal transportation
    - Modified atmosphere transport

Tools and equipment required for demonstrations: sample packages used to show stacking patterns, stacking strength, palletization tools (tape, corner boards, etc.), braces, air pillows, illustrations of proper loading patterns for each type of shipping.

Proposed Instructors
Dr. Adel A. Kader, University of California, Davis.
Topics: Harvest maturity and quality standards, phytosanitary standards, general handling practices for fruits and vegetables, temperature/relative humidity effects on produce quality, the future of transportation practices.

Dr. Lisa Kitinoja, Extension Systems International

Topics: Causes and sources of post-harvest problems, general small-scale post-harvest handling practices for fruits and vegetables, problems with "just-in-time" handling without cooling, small-scale cooling practices, cost/benefit analyses.

Mr. Brian McGregor, USDA/AMS/Transportation and Marketing Programs
Topics: Packaging, general handling practices, loading/unloading, recommended temperatures for transport, transportation practices for fresh produce.

Mrs. Heidi Reichert, USDA/AMS/Transportation and Marketing Programs
Topics: Grades and standards, management of transportation for export, shipping practices, reducing shipping costs.

Update of the Training Manual

Draft Table of Contents:

Acknowledgements
Introduction to the manual
- Post-harvest handling steps for a typical commodity
- Principal causes of post-harvest losses and poor quality
- Resources for quality assurance and export marketing

Chapter 1: Harvesting and preparation for market
- Maturity standards
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- Harvesting containers
- Harvesting tools
- Field packing
- Transport to the packinghouse

Chapter 2: Curing root, tuber and bulb crops
- Field curing
- Curing with heated air
- Bulk systems for curing onions
- Emergency curing

Chapter 3: Packinghouse operations
- General operations
- Dumping
- Washing
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- Sorting
- Sizing
- Fruit packing line

Chapter 4: Packing and packaging materials

- Packing practices
- Packing containers
- Packaging practices
- Labeling
- Modularization of containers
- Modified atmosphere packaging (MAP)
- Unit loads

Chapter 5: Decay and insect control

- Chemical controls
- Controlled/modified atmosphere treatments
- Heat treatments

Chapter 6: Temperature and relative humidity control

- Room cooling
- Forced-air cooling
- Hydro-cooling
- Evaporative cooling
- Night air ventilation
- Chilling injury
- Use of ice
- Alternative methods of cooling
- Increasing relative humidity

Chapter 7: Storage of horticultural crops

- Recommended storage temperatures
- Compatibility groups for storage of fruits, vegetables and floral crops
- Storage practices
- Storage structures
- Dried and bulb crops
- Root and tuber crops
- Potatoes
- Controlled atmosphere (C.A.) storage
- Relative perishability and storage life of fresh horticultural crops

Chapter 8: Transportation of horticultural crops

- Open vehicles
- Refrigerated trailers
- Stacking patterns/hand-stacked
- Stacking patterns/pallet and slip sheet loads
- Bracing the load

Chapter 9: Handling at destination

- Unloading
- Storage temperatures
- Sorting/repacking
- Ripening
- Display

Chapter 10: Processing of horticultural crops

- Preparation for processing
- Solar drying
- Forced-air dehydrators
- Oil-burning dehydrators
- Electric dehydrators
- Oven drying
- Canning
- Juicing
- Other methods of processing

General references

Sample pages from the manual

1) Curing

Curing root and tuber crops such as sweet potatoes, potatoes, cassava and yarns is an important practice if these crops are to be stored for any length of time before being sold or consumed. Curing is accomplished by holding the produce at high temperature and high relative humidity for several days while harvesting wounds heal and a new, protective layer of cells form. While curing can be initially costly, the long extension of storage life and the reduction of post-harvest losses makes the practice economically worthwhile.

The best conditions for curing vary among crops as shown in the following table:

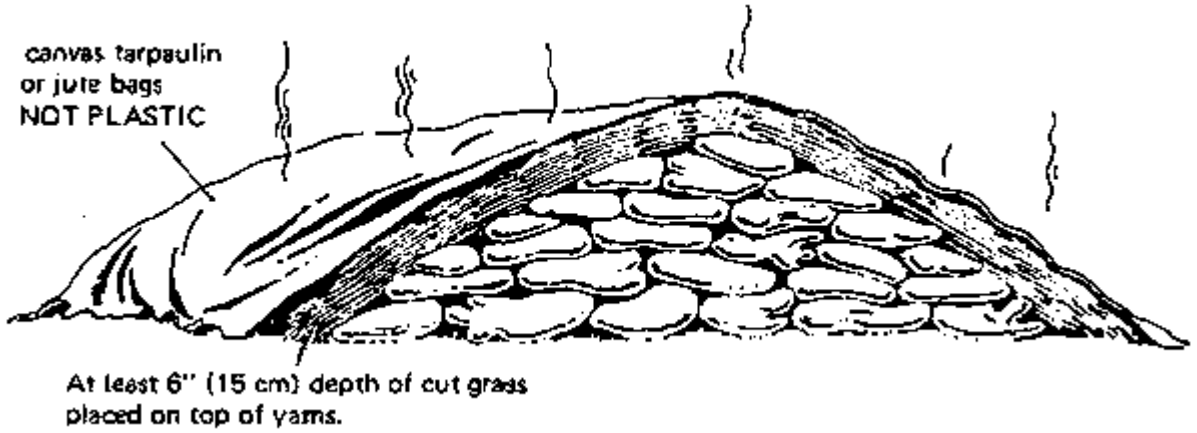
Commodity	Temperature		Relative Humidity	Days
	C	F	(%)	
Potato	15-20	59-68	90-95	5-10
Sweet potato	30-32	86-90	85-90	4-7
Yarns	32-40	90-104	90-100	1-4
Cassava	30-40	86-104	90-95	2-5

2) Field curing

Yams and other tropical root and tuber crops can be cured outdoors if piled in a partially shaded area. Cut grasses or straw can be used as insulating materials and the pile should be covered

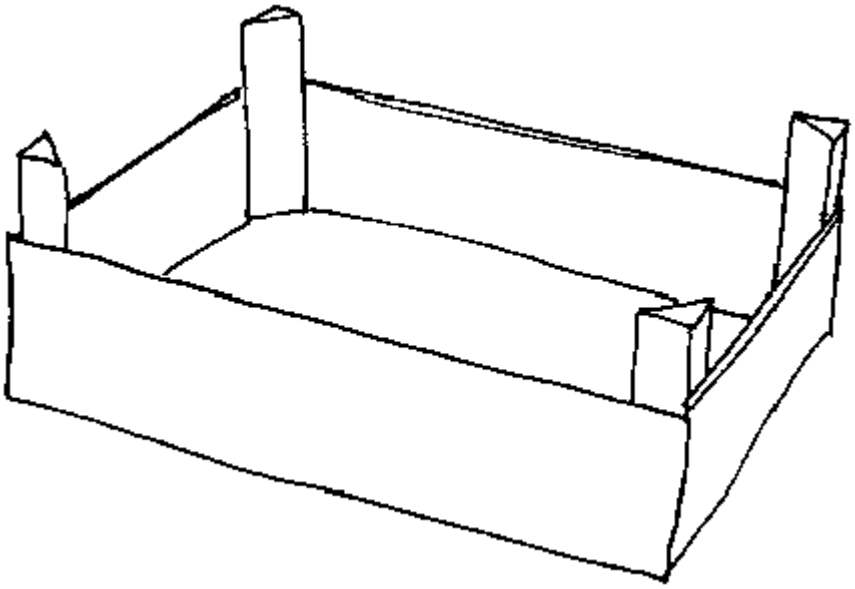
with canvas, burlap or woven grass mats. Curing requires high temperature and high relative humidity, and this covering will trap self-generated heat and moisture. The stack should be left for about four days.

Cut-away view of yam curing



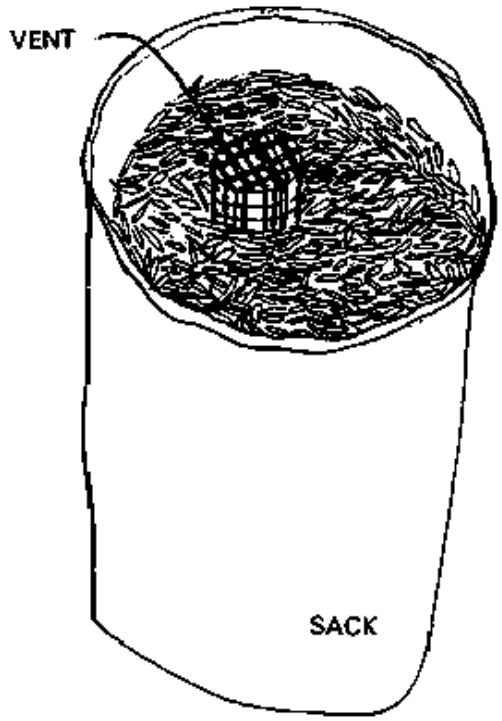
Source: Wilson, J. No date. Careful Storage of Yams: Some Basic Principles to Reduce Losses. London: Commonwealth Secretariat/International Institute of Tropical Agriculture. (IITA, Ibadan, Nigeria.)

3) Packages: A simple wooden tray with raised corners is stackable and allows plenty of ventilation for fragile crops such as ripe tomatoes.



Source: FAO. 1985. Prevention of Post-Harvest Food Losses: A Training Manual. Rome: UNFAO. 120pp

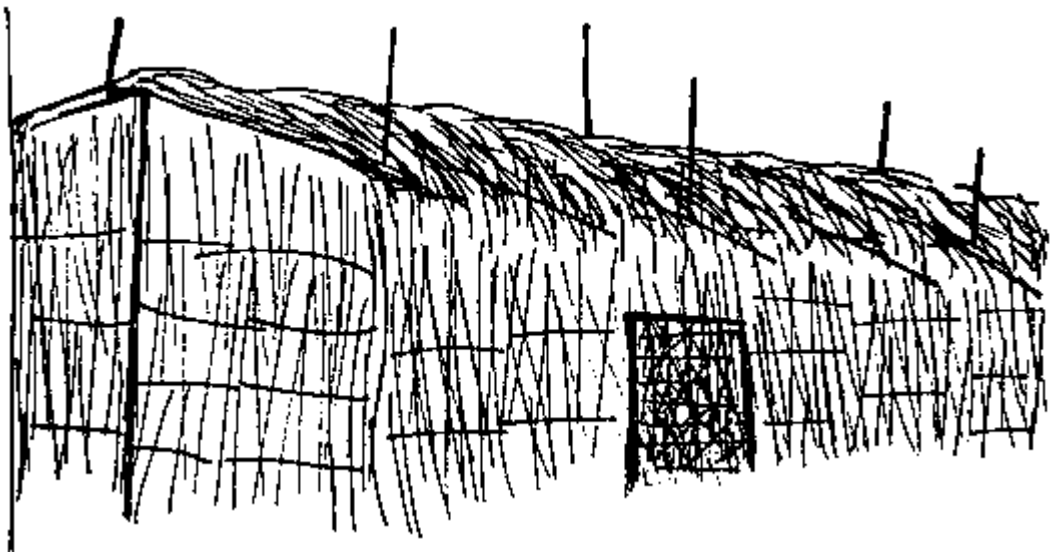
If large bags or baskets must be used for bulk packaging of fruits or vegetables, the use of a simple vent can help reduce the buildup of heat as the product respires. In the illustration below, a tube of woven bamboo (about one meter long) is used to vent a large bag of chili peppers.



4) Evaporative cooling

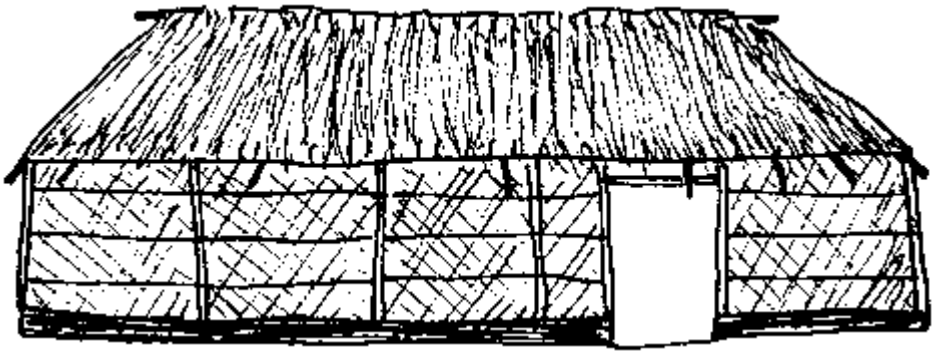
These packinghouses are made from natural materials that can be moistened with water. Wetting the walls and roof first thing in the morning creates conditions for evaporative cooling of a packinghouse that is made from straw.

Straw packinghouse:



The packinghouse illustrated below is made with walls of wire mesh that hold charcoal. By moistening the charcoal with water each morning, the structure will be evaporatively cooled during the day.

Straw packinghouse:



Source: FAO. 1986. Improvement of Post-Harvest Fresh Fruits and Vegetables Handling- A Manual. Bangkok: UNFAO Regional Office for Asia and the Pacific.

5) Temporary Storage Temperatures

When produce is held at destination for a short time before marketing, the handler can help maintain quality and reduce losses by storing commodities at their most suitable temperature. However, if the storage period is five days or less, relative humidity is maintained between 85 and 95%, and the ethylene level is kept below 1 ppm ventilating or using a scrubber, most commodities can be grouped into the following three categories.

Vegetables and Melons				
32-36°F, 0-2°C			**45-50°F, 7-10°C**	**60-65°F, 16-18°C**
anise	collard*	parsnip	basil	casaba melon
artichoke	cut vegetables	raddichio	beans; snap, etc.	cassava
arugula*	daikon*	radish	cactus leaves	crenshaw melon
asparagus*	endive*	rutabaga	cucumber*	dry onions
bean sprouts	escarole*	rhubarb	eggplant*	ginger
beet	garlic	salsify	Juan Canary melon	honeydew melon
Belgian endive*	green onion*	shallot		jicama
bok choy	herbs(not basil)	spinach*	kiwano	potato

broccoli*	horseradish	snow pea*	okra*	Persian melon
broccoflower*	Jerusalem	sweet corn	pepper; bell,	pumpkin
brussel sprouts*	artichoke	sweet pea*	chili	squash; winter,
cabbage*	kale	Swiss chard	squash; summer,	hard rind
cantaloupe	kohlrabi	turnip	rind*	sweet potato*
carrot*	leek*	turnip greens*	tomatillo	taro
cauliflower*	lettuce*	waterchestnut	watermelon*	tomato; ripe
celeriac	mint	watercress*		mature green
celery*	mushroom			yam*
chard*	mustard greens*			
chicory*	parsley*			
* Products marked with an asterisk are sensitive to ethylene damage.				

Fruits				
32-36°F, 0-2°C			**45-50°F, 7-10°C**	**60-65°F, 16-18°C**
apple	kiwifruit*		avocado, unripe	atemoya
apricot	nectarine		carambola	banana
avocado, ripe	peach		chayote	breadfruit
blackberry	pear; Asian		cranberry	cherimoya
blueberry	European		feijoa	coconut
cherry	persimmon*		guava	grapefruit*
currant	plum		kumquat	lemon*
cut fruits	prune		longan	lime*
date	quince		lychee	mango
fig	raspberry		mandarin	mangosteen
gooseberry	strawberry		olive	papaya
grape			orange	plantain

			passion fruit	pummelo
			pineapple	rambutan
			pomegranate	sapote
			tamarillo	soursop
			tangelo	
			tangerine	
* Products marked with an asterisk are sensitive to ethylene damage.				

Source: Thompson, J.F. and Kader, A.A. 1995. Post-harvest Outreach Program, University of California, Davis.

6) Small-scale on-farm Cooling

USDA PORTACOOLER - In the USDA post harvest cooling program, we are stressing to small growers the need to: a) sort and grade produce out of the field, b) package the produce properly for the market, c) immediately cool the produce to remove field heat.

This small cooler uses a 12,000 BTU/hr (1 ton) 110 volt room window air conditioner to cool air inside the insulated box. The cool air inside the front of the box is forced through the produce by a pressure fan in a second wall inside. The return air passes under a false floor to the front of the box.

The Portacooler was built by a cooperating team at USDA, Beltsville, Maryland, to primarily cool highly perishable berries and other air cooled produce.

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www.pma.com, Produce Marketing Association

www.produceworld.com, Produce World classified produce marketing advertisements.

Appendices

Appendix A: U.S. Import Data by Country

EGGPLANT						
COUNTRY	JANUARY-DECEMBER IMPORTS					
	QUANTITY (MT)		VALUE (US $)		UNIT VALUE (US $)	
	1999	2000	1999	2000	1999	2000
(0001) WORLD	32,427	38,918	$21,982,872	$24,084,151	$677.92	$618.85
(0020) LATIN AMERICA	32,152	38,534	$21,686,667	$23,310,485	$674.51	$604.93
(0022) CENTRAL AMERICA	1,483	2,497	$656,475	$1,077,952	$442.76	$431.62
(0023) CARIBBEAN	2	18	$2,288	$11,575	$1,318.73	$634.35
(0030) W EUROPE	93	343	$178,325	$741,305	$1,927.30	$2,160.04
(0031) EUROPEAN UNION	93	343	$178,325	$741,305	$1,927.30	$2,160.04
(0060) ASIA		3		$12,449		$4,690.66
(0061) W ASIA (MIDEAST)		3		$12,449		$4,690.66
(0303) BELGIUM AND LUXEMBOURG		1		$2,176		$3,400.00
(0306) ITALY, INCL. SAN MARINO AND VATICAN CITY		26		$51,223		$1,945.13
(0601) ISRAEL, INCL. GAZA STRIP AND WEST BANK		3		$12,449		$4,690.66
(1220) CANADA	182	38	$117,880	$19,912	$645.95	$528.32
(2010) MEXICO	30,667	36,018	$21,027,904	$22,220,958	$685.68	$616.94
(2150) HONDURAS	1,316	2,292	$582,567	$998,672	$442.52	$435.66
(2190) NICARAGUA	166	205	$73,908	$79,280	$444.67	$386.39
(2470) DOMINICAN REPUBLIC	2	18	$2,288	$11,575	$1,318.73	$634.35
(4210) NETHERLANDS	93	316	$178,325	$687,906	$1,927.30	$2,175.42
(4231) BELGIUM		1		$2,176		$3,400.00
(4759) ITALY		26		$51,223		$1,945.13
(5081) ISRAEL		3		$12,449		$4,690.66

Source: Foreign Agricultural Trade of the United States (FATUS), 2001

MANGOES						
COUNTRY	JANUARY-DECEMBER IMPORTS					
	QUANTITY (MT)		VALUE (US $)		UNIT VALUE (US $)	
	1999	2000	1999	2000	1999	2000
(0001) WORLD	228,777	239,871	$150,976,685	$144,926,575	$659.93	$604.18
(0020) LATIN AMERICA	228,640	239,819	$150,883,711	$144,859,860	$659.92	$604.04
(0022) CENTRAL AMERICA	11,529	11,564	$6,215,811	$7,958,947	$539.15	$688.26
(0023) CARIBBEAN	9,366	10,354	$6,908,664	$7,344,039	$737.62	$709.31
(0024) S AMERICA	35,628	47,288	$32,373,412	$37,271,327	$908.64	$788.17
(0030) W EUROPE		2		$5,040		$3,000.00
(0031) EUROPEAN UNION		2		$5,040		$3,000.00
(0060) ASIA	117	48	$76,802	$54,115	$656.81	$1,133.20
(0062) S ASIA	27	39	$26,516	$39,873	$970.57	$1,026.54
(0065) SOUTHEAST ASIA	90	9	$50,286	$14,242	$561.16	$1,598.07
(0070) OCEANIA	17		$12,247		$742.24	
(0201) LEEWARD AND WINDWARD ISLANDS	2	8	$2,634	$7,072	$1,592.50	$912.87
(0304) FRANCE, INCL. ANDORRA AND MONACO		2		$5,040		$3,000.00
(0706) OTHER PACIFIC ISLANDS, NEC	17		$12,247		$742.24	
(1220) CANADA	3	3	$3,925	$7,560	$1,331.41	$2,314.76
(2010) MEXICO	172,117	170,613	$105,385,824	$92,285,547	$612.29	$540.91
(2050) GUATEMALA	9,605	8,427	$4,287,245	$4,388,002	$446.37	$520.68
(2110) EL SALVADOR	3	15	$20,612	$21,542	$6,365.66	$1,471.35
(2150) HONDURAS	143	88	$174,773	$142,480	$1,224.53	$1,614.54
(2190) NICARAGUA	678	1,546	$1,067,056	$2,173,760	$1,573.36	$1,405.71
(2230) COSTA RICA	1,100	1,487	$666,125	$1,233,163	$605.55	$829.17
(2410) JAMAICA	6		$6,500		$1,157.41	
(2450) HAITI	9,161	10,163	$6,715,491	$7,121,483	$733.06	$700.74

(2470) DOMINICAN REPUBLIC	198	183	$184,039	$215,484	$929.62	$1,175.95
(2488) ST. VINCENT AND THE GRENADINE		5		$5,040		$925.96
(2489) GRENADA	2	2	$2,634	$2,032	$1,592.50	$881.94
(3010) COLOMBIA	69	78	$101,863	$119,233	$1,481.69	$1,535.10
(3070) VENEZUELA	408	101	$358,970	$89,847	$879.61	$890.79
(3310) ECUADOR	10,823	17,658	$7,045,801	$9,913,734	$651.01	$561.44
(3330) PERU	11,507	12,426	$13,089,421	$13,479,134	$1,137.53	$1,084.73
(3370) CHILE		39		$39,120		$1,000.00
(3510) BRAZIL	12,822	16,987	$11,777,357	$13,630,259	$918.54	$802.41
(4279) FRANCE		2		$5,040		$3,000.00
(5330) INDIA	27	39	$26,516	$39,873	$970.57	$1,026.54
(5490) THAILAND		6		$12,184		$2,040.19
(5520) VIETNAM		3		$2,058		$700.00
(5590) SINGAPORE	1		$2,650		$4,424.04	
(5650) PHILIPPINES	89		$47,636		$535.16	
(6863) FIJI	17		$12,247		$742.24	

Source: Foreign Agricultural Trade of the United States (FATUS), 2001

OKRA, FRESH OR FROZEN						
COUNTRY	JANUARY-DECEMBER IMPORTS					
	QUANTITY (MT)		VALUE (US $)		UNIT VALUE (US $)	
	1999	2000	1999	2000	1999	2000
(0001) WORLD	22,390	24,313	$11,373,778	$12,262,666	$508.00	$504.36
(0020) LATIN AMERICA	22,200	24,052	$11,129,866	$11,944,537	$501.35	$496.61
(0022) CENTRAL AMERICA	4,759	4,163	$3,359,338	$2,422,812	$705.94	$582.05
(0023) CARIBBEAN		2		$2,688		$1,606.69
(0060) ASIA	7	39	$7,107	$51,591	$1,050.09	$1,315.79
(0061) W ASIA (MIDEAST)	2	35	$3,840	$43,349	$1,666.67	$1,239.32
(0065) SOUTHEAST ASIA	4	4	$3,267	$8,242	$731.85	$1,948.00
(0080) AFRICA	183	222	$236,805	$266,538	$1,295.31	$1,201.67
(0081) N AFRICA	183	222	$236,805	$266,538	$1,295.31	$1,201.67
(2010) MEXICO	17,441	19,888	$7,770,528	$9,519,037	$445.53	$478.63
(2050) GUATEMALA	3,155	3,740	$2,216,756	$2,109,779	$702.51	$564.17
(2110) EL SALVADOR	1,398	300	$984,880	$234,013	$704.37	$781.08
(2190) NICARAGUA	205	123	$157,702	$79,020	$769.44	$640.82
(2470) DOMINICAN REPUBLIC		2		$2,688		$1,606.69
(4890) TURKEY		17		$20,250		$1,171.88
(5040) LEBANON	2	9	$3,840	$11,789	$1,666.67	$1,367.95
(5110) JORDAN		9		$11,310		$1,245.59
(5490) THAILAND	4		$3,267		$731.85	
(5520) VIETNAM		4		$8,242		$1,948.00
(7290) EGYPT	183	222	$236,805	$266,538	$1,295.31	$1,201.67

Source: Foreign Agricultural Trade of the United States (FATUS), 2001

PINEAPPLES, FRESH OR FROZEN						
	JANUARY-DECEMBER IMPORTS					
	QUANTITY (MT)		VALUE (US $)		UNIT VALUE (US $)	
	1999	2000	1999	2000	1999	2000
(0001) WORLD	286,980	322,637	$125,263,014	$133,993,143	$436.49	$415.31
(0020) LATIN AMERICA	284,549	319,252	$121,719,466	$129,698,144	$427.76	$406.26
(0022) CENTRAL AMERICA	263,919	294,467	$113,888,688	$120,817,996	$431.53	$410.29
(0023) CARIBBEAN	29	711	$29,970	$512,898	$1,029.01	$721.06
(0024) S AMERICA	5,393	6,608	$1,786,157	$1,992,505	$331.22	$301.53
(0030) W EUROPE		4		$19,446		$5,120.06
(0031) EUROPEAN UNION		4		$19,446		$5,120.06
(0060) ASIA	2,428	3,333	$3,538,868	$4,243,493	$1,457.34	$1,273.07
(0062) S ASIA		13		$74,019		$5,753.07
(0065) SOUTHEAST ASIA	2,311	3,120	$3,473,966	$4,068,880	$1,503.05	$1,304.24
(0080) AFRICA		47		$32,060		$676.57
(0082) SUB-SAHARA		47		$32,060		$676.57
(1220) CANADA	2		$4,680		$2,702.08	
(2010) MEXICO	15,209	17,466	$6,014,651	$6,374,745	$395.46	$364.99
(2050) GUATEMALA	1,744	763	$498,322	$255,073	$285.65	$334.44
(2150) HONDURAS	33,555	32,917	$7,483,945	$8,252,588	$223.03	$250.71
(2230) COSTA RICA	228,619	260,663	$105,906,421	$112,268,909	$463.24	$430.71
(2250) PANAMA		125		$41,426		$332.70
(2470) DOMINICAN REPUBLIC	29	711	$29,970	$512,898	$1,029.01	$721.06
(3010) COLOMBIA	47	45	$76,095	$80,841	$1,614.99	$1,816.41
(3310) ECUADOR	5,346	6,505	$1,710,062	$1,824,499	$319.90	$280.48
(3330) PERU		56		$83,952		$1,500.00
(3510) BRAZIL		2		$3,213		$1,350.00
(4210) NETHERLANDS		4		$19,446		$5,120.06
(5420) SRI LANKA		13		$74,019		$5,753.07
(5490) THAILAND	2,135	2,837	$3,346,233	$3,887,225	$1,567.26	$1,370.06

(5520) VIETNAM	156	225	$96,621	$117,431	$618.56	$521.09
(5590) SINGAPORE	16		$22,680		$1,417.50	
(5600) INDONESIA	4		$8,432		$2,108.00	
(5650) PHILIPPINES		57		$64,224		$1,124.84
(5700) CHINA (MAINLAND)	117	201	$64,902	$100,594	$554.59	$501.23
(7490) GHANA		43		$18,086		$419.18
(7910) REPUBLIC OF SOUTH AFRICA		4		$13,974		$3,295.75

Source: Foreign Agricultural Trade of the United States (FATUS), 2001

Appendix B: Outline of the Commodity System

Interviews and Observations:

Commodity _____ Date_____

Components 1 - 7: Pre-Production
1- Importance of the crop.
What is the relative importance of the crop?
number of producers
amount produced
area of production
relative value

2- Governmental policies.
Are there any laws, regulations, incentives or disincentives related to producing or marketing the crop? (e.g., existing price supports or controls, banned pesticides or residue limits)

3- Relevant institutions.
Are there any organizations involved in projects related to production or marketing the crop?
What are the goals of the projects?
How many people are participating?

4- Facilitating services. What services are available to producers and marketers of the crop?
for example: credit
inputs
technical advice
subsidies
Other

5- Producer/shipper organizations.
Are there any producer or marketer organizations involved with the crop?
What benefits or services do they provide to participants?
At what cost?

6- Environmental conditions.
Does the local climate, soils or other factors limit the quality of production?
Are the cultivars produced appropriate for the location?

7- Availability of planting materials.
Are seeds or planting materials of adequate quality?
Can growers obtain adequate supplies when needed?

Components 8 - 11: Production
8- Farmers' general cultural practices.

Do any farming practices in use have an effect on produce quality?
For example: irrigation, weed control practices, fertilization practices, field sanitation, other

9- Pests and diseases.
Are there any insects, fungi, bacteria, weeds or other pests present that affect the quality of produce?

10- Pre-harvest treatments.
What kinds of pre-harvest treatments might affect post-harvest quality?
For example: use of pesticides, pruning practices, thinning, other

11- Production costs.
Estimate the total cost of production (inputs, labor, rent, etc).
What are the costs of any proposed alternative methods?

Components 12 - 21: Post-harvest
12- Harvest.
When and how is produce harvested? by whom? at what time of day? Why?
What sort of containers are used?
Is the produce harvested at the proper maturity for the intended market?

13- Grading and inspection.
How is produce sorted? by whom?
Does value (price) change as quality/size grades change?
Do local, regional or national standards (voluntary or mandatory) exist for inspection?
What happens to culled produce?

14-Post-harvest treatments.
What kinds of post-harvest treatments are used?
(Describe any curing practices, cleaning, trimming, hot water dips, etc.)
Are treatments appropriate for the product?

15- Packaging.
How is produced packed for transport and storage?
What kind of packages are used?
Are packages appropriate for the product?
Well suited to the intended market?
Can they be reused or recycled?

16- Cooling. When and how is produce cooled?
To what temperature? Using which method(s)?
Are cooling methods appropriate for the product?

17- Storage.
Where and for how long is produce stored?
In what type of storage facility?

Under what conditions (packaging, temperature, RH, physical setting, hygiene, inspections, etc.)?

18- Transport.
How many times is produce transported between the farm and the destination market?
By whom?
How is produce loaded and unloaded at each transfer point?
What type(s) of transport are involved? (organize responses by road, marine, air or rail)

Road:
How and for what distance is produce transported?
In what type of vehicle?
Under what type of conditions?

Marine:
How and for what distance is produce transported?
In what type of vehicle?
Under what type of conditions?

Air:
How and for what distance is produce transported?
In what type of vehicle?
Under what type of conditions?

Rail:
How and for what distance is produce transported?
In what type of vehicle?
Under what type of conditions?

19- Delays/ waiting.
Are there any delays during handling?
Where, for how long, and under what conditions (temperature, RH, physical setting) does produce wait between steps?

20- Other handling.
What other types of handling does the produce undergo?
Is there sufficient labor available?
Is the labor force well trained for proper handling from harvest through transport?
Would alternative handling methods reduce losses?
Would these methods require new workers or displace current workers?

21- Agro-processing.
How is the commodity processed (methods, processing steps) and to what kinds of products?
How much value is added?
Are sufficient facilities, equipment, fuel, packaging materials and labor available for processing?
Is there consumer demand for processed products?

Is processing costs effective?

Components 22 - 26: Marketing
22- Market intermediaries.
Who are the handlers of the crop between producers and consumers?
How long do they have control of produce and how do they handle it?
Who is responsible for losses /who suffers financially?
Is produce handled on consignment; marketed via direct sales; move through wholesalers?

23- Market information.
Do handlers and marketers have access to current prices and volumes in order to plan their marketing strategies?
Who does the recordkeeping?
Is information accurate, reliable, timely, and useful to decision makers?

24- Consumer demand.
Do consumers have specific preferences for produce sizes, flavors, colors, maturities, quality grades, packages types, package sizes or other characteristics?
Is there any sign of unmet demand and/or over-supply?
How do consumers react to the use of post-harvest treatments (pesticides, irradiation, coatings, etc.) or certain packaging methods (plastic, Styrofoam, recyclables)?

25- Exports.
What are the specific requirements for export?
(regulations of importing countries with respect to grades, packaging, pest control, etc.)?

26- Credit.
Do handlers/marketers have access to credit?
Are prevailing market interest rates at a level that allows the borrower to repay the loan and still make a profit?

27- Supporting Infrastructure.
Is supporting infrastructure adequate?
roads
marketing facilities
management skills of staff
communication systems such as telephone, FAX, e-mail services)?

28- Marketing costs.
Estimate the total marketing costs for the crop (inputs and labor for harvest, packaging, grading, transport, storage, processing, etc.).
What are the relative costs for any alternative handling or marketing methods proposed?

Appendix C: Schedule of Meetings, Interviews and Site Visits

March 11, 2002

Embassy of the USA – Mr. Yaw Asante Kwahbiah, Michael S. Owen, David Rosenbloom
Ministry of Food & Agriculture – Dr. Francis Ofori, Mr. Vesper Suglo, Dr. Bertha Gana
Ministry of Roads & Transport -- Chief Director and all the department heads
Ministry of Trade and Industry – Mr. Ben A. Peasah
Railway Enginemen's Union—General Secretary Issac Anaful Oboh

March 12, 2002

Cocoa Marketing Co. (GH) Ltd.—Kwadwo Kissiedu Kwapong
Port Tour - Tema Ports Authority
Ministry of Agriculture at the Port of Tema
AFGO, Kotoka International Airport
Ghana Civil Aviation Authority, Kotoka International Airport—Captain Joe A. Boachie
Ghana Standards Board— executive Director Alex O. Ntiforo and department heads
Institute of Statistical, Social & Economic Research (ISSER), University of Ghana—professor Kwadwo Asenso-Okeyere and 7 colleagues

March 13, 2002

Equator Farms (Pineapple)
Paradise Farms Ltd. (Papaya)
Village Extension Worker interviews
Local village farms (okra) along road to Amasaman
MOFA Extension Services in Amasaman

March 14, 2002

Ceba Market, Mallam, Odorkor Road
31st December Women's Market
Horticultural Association of Ghana (HAG)—executive board members
Sea Freighted Pineapple Exporters Association of Ghana (SPEG)—executive board members
Vegetable Producers and Exporters Association of Ghana (VEGPEAG)—executive board members
AMEX International, Inc.—Chief of Party, David Esch

March 15, 2002

Food & Drug Board—Kwamina Van-Ess and staff members
High-end Roadside Produce Stand, Accra
Max-mart (supermarket)
USAID/Office of Trade, Agriculture, & Private Sector-- Mr. Fenton Sands
Ministry of Food and Agriculture, Market Access Working Group Members

Appendix D: USDA Grades and Standards

As a basis for its fresh products grading, USDA has developed 158 official grade standards for 85 fresh fruits, vegetables, tree nuts, peanuts, and related commodities. They describe the quality requirements for each grade of commodity, giving industry a common language for buying and selling. USDA works to ensure that the standards are uniformly applied throughout the country. If a request for official grading is based on U.S. grade standards, the official certificate covering the shipment will show which USDA grade the product meets. These certificates are accepted as legal evidence in all Federal courts. For more information about USDA's grades and standards, visit their website at: http://www.ams.usda.gov/fv/fvstand.htm.

The following files were downloaded from the above website for the commodities of focus during this assessment. Each contains the official grades and standards for the product, as determined by the USDA.

- Pineapple
- Sweet Potato
- Eggplant
- Okra
- Avocado
- Green Beans
- Watermelon

Appendix E: Produce Facts for Key Commodities

The University of California at Davis' Post-harvest Technology Research and Information Center hosts a website that provides basic recommendations for proper post-harvest handling for many fresh fruits and vegetables.

Here are selected "Produce Sheets" for key commodities produced in Ghana. If others are of interest, visit the website at http://postharvest.ucdavis.edu.

- Pineapple
- Papaya
- Mangoes
- Sweet potato
- Eggplant
- Okra
- Avocado
- Green beans
- Watermelon

Appendix F: Import Requirements for the United States

Sanitary and phytosanitary (SPS) issues play an important role in agricultural trade. USDA's Animal & Plant Health Inspection Service (APHIS) enforces animal and plant import and export regulations to help ensure that foreign pests and diseases are not introduced into this country and that U.S. agricultural products meet the standards of importing countries. APHIS-PPQ (Plant Protection and Quarantine) safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests and noxious weeds. Fulfilment of its safeguarding role ensures an abundant, high-quality, and varied food supply; strengthens the marketability of U.S. agriculture in domestic and international commerce; and contributes to the preservation of the global environment.

The PPQ manual titled *Regulating the Importation of Fruits and Vegetables* covers all fresh fruits and vegetables (including fresh herbs and sprouts) that are imported from any foreign country, from Palau, from the Federated States of Micronesia, or from the Commonwealth of the Northern Mariana Islands. These fresh fruits, vegetables, and herbs must be intended for consumption—not propagation. Only the approved plant part(s) of the fresh fruits, vegetables, and herbs is allowed entry. This manual also has the procedures for regulating foreign produce that is transiting the United States.

The entire manual is available at:
http://www.aphis.usda.gov/ppq/manuals/pdf_files/FV%20Chapters.htm

Excerpt from the manual:

- Preference section and products allowed into the United States from Ghana

The U.S. Food & Agricultural Import Regulations and Standards (FAIRS) provided by USDA's/Foreign Agricultural Service contains market access reports which aim to consolidate general information on the technical requirements (e.g., food laws, labelling, import procedures, etc.) for food and agricultural imports. This report is available at:
http://www.fas.usda.gov/itp/ofsts/us.html

Click here to link to read a brochure describing the regulatory contact information regarding the importation of food and agricultural products into the United States.

Appendix G: Comparative Shipping Data

The tables below provide quantity, rate, and time information about the top countries who shipped in containers pineapple, eggplant, and papaya to the United States during the year 2001. The data was compiled using a variety of resources. The number of TEU's (twenty-foot equivalent units) was calculated using PIERS (Port Import Export Reporting Service), *Journal of Commerce*, New York, 2001. The ranges of sample rates were estimated based on the publicly filed tariffs (filed with the Federal Maritime Commission) available using OceanRate-Vista™. Since not all shipping lines make their tariffs public through OceanRate-Vista™, this range is based on just a sampling of rates. (Source: www.etransport.com) The range of transit times were determined using www.shipguide.com, a website that offers transit times for most shipping lines operating in worldwide trade lanes.

Pineapple

Country	TEUs	Sample Rates*	Transit times**
Costa Rica	3956	$1500 - $3300	13-20 Days
Honduras	1946	$2200 - $2500	3-10 Days
Philippines	1037	$3700 - $5600	12-23 Days
Ecuador	865	$3500 - $4600	9-15 Days
Thailand	518	$3000 - $5100	17-24 Days
Dominican Republic	125	$1500 - $3300	3-10 Days
Ghana* **	**2**	**$3500 - $6000**	**17-33 Days**

Eggplants

Country	TEUs	Sample Rates*	Transit times**
Honduras	254	$2200 - $3200	3-10 Days
Dominican Republic	52	$1200 - $3200	3-10 Days
Nicaragua	9	$3000 - $4000	1-5 Days
Costa Rica	6	$2000 - $3000	13-20 Days
Ghana* **	**1**	**$3500 - $6000**	**17-33 Days**

Papaya

Country	TEUs	Sample Rates*	Transit times**
Belize	821	$2200 - $3000	4-10 Days
Dominican Republic	417	$1800 - $2700	3-10 Days
Panama	54	$2200 - $3700	4-11 Days
Ecuador	39	$2600 - $4600	9-15 Days
Ghana* **	**1**	**$3500 - $6000**	**17-33 Days**

Based solely on the transportation data provided above, Ghana is comparatively disadvantaged in terms of the time and cost required to get fresh produce to the United States. However, these factors are not a major trade barrier. Produce can be successfully shipped at longer transit times

because technology in temperature controlled transport facilities can maintain product quality while in transit. Temperatures for these three commodities should be maintained at 10 to 13 C.

Unfortunately eggplant has a maximum shelf life in air of about 14 days, and even under CA conditions (which cost an additional $1500 or so per40 ft container) the maximum shelf life is only 21 days. Papaya is a little better, but maximum shelf life in air is only 21 days, while under CA conditions it can be extended to 28 days. Only pineapple can be transported in air under refrigeration for up to 28 days, and with CA shelf life can be extended to six weeks.

It would therefore be necessary to use both the costlier CA transport some commodities and to manage planting and harvest to better match specific shipping schedules to ensure that the quickest routes were selected.

Further, through good transportation management, these costs can be reduced. See Training Needs. Nonetheless, it is imperative that other factors (such as price and demand) be considered for each product through an in depth marketing study to determine which products are best suited and have the most potential for the U.S. market.

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*The rate offered to a shipper varies depending on the shipping line, commodity, container size and type, and services requested.

**Transit times are based on departures from the U.S. East and Gulf Coasts to the main container ports of each country.

***Due to the relatively few shipments of produce entering the United States from Ghana, tariff rates for fresh produce were not available at the time of this research. However, since rates for all containerized refrigerated products are often similar, rates for frozen seafood and poultry imported into the United States are used instead.

Appendix H: Websites for Further Information

- *Grades and Standards, Phytosanitary Regulations*

http://www.ams.usda.gov
http://www.ams.usda.gov/fv/ (Fruit & Vegetable Programs)
http://www.ams.usda.gov/tmd/ (Transportation & Marketing Programs)
"Agricultural Marketing Service at the U.S. Department of Agriculture
The Agricultural Marketing Service includes six commodity programs--Cotton, Dairy, Fruit and Vegetable, Livestock and Seed, Poultry, and Tobacco. The programs employ specialists who provide standardization, grading and market news services for those commodities. They enforce such Federal Laws as the Perishable Agricultural Commodities Act and the Federal Seed Act. AMS commodity programs also oversee marketing agreements and orders, administer research and promotion programs, and purchase commodities for Federal food programs."

http://www.aphis.usda.gov/
"The mission of the Animal and Plant Health Inspection Service (APHIS) is to protect America's animal and plant resources by:

- Safeguarding resources from exotic invasive pests and diseases,
- Monitoring and managing agricultural pests and diseases existing in the United States,
- Resolving and managing trade issues related to animal or plant health, and
- Ensuring the humane care and treatment of animals."

http://www.aphis.usda.gov/ppq/manuals/online_manuals.html
A list of APHIS/Plant Protection and Quarantine Manuals that are available electronically.

http://www.aphis.usda.gov/ppq/manuals/pdf_files/FV%20Chapters.htm
Regulating the Importation of Fresh Fruits and Vegetables – (This complete handbook is available online.)

http://www.eurep.org
http://www.ehi.org
Eurep GAP Standard. EHI is the accreditation body for EUREP GAP. It's website contains information about EHI and EUREP.

- *Marketing of Agricultural Products, Statistics*

http://www.ers.usda.gov/db/fatus/
"Foreign Agricultural Trade of the United States (FATUS) is a database of U.S. agricultural exports and imports, by commodity, with all countries and regions of the world. FATUS is a standard aggregation of the original U.S. trade data found in the code system Harmonized Tariff Schedule (HTS) of the United States. The original HTS data is disseminated by the Census Bureau of the U.S. Department of Commerce."

http://www.fas.usda.gov/import.html
"The Foreign Agricultural Service (FAS) of the U.S. Department of Agriculture (USDA) works to improve foreign market access for U.S. products. FAS operates programs designed to build

new markets and improve the competitive position of U.S. agriculture in the global marketplace."

http://www.fas.usda.gov/itp/ofsts/fairs_by_country_results.asp?Cntry=US
"The *FAIRS Country Report* is a *market access report* which covers all processed food products including processed fishery products, bulk and intermediate products including feedstuffs. The most recent FAIRS Country report is shown below along with any new *updated* FAIRS reports received during the calendar year. All updated FAIRS reports are incorporated annually into the FAIRS Country report." This link connects directly to the U.S. FAIRS Report.

http://ia.ita.doc.gov/
Department of Commerce Import Administration Website – including links to statistics, policies, and import regulations

http://www.agoa.gov/
President Clinton signed the African Growth and Opportunity Act (AGOA) into law on May 18, 2000 as Title 1 of The Trade and Development Act of 2000. The Act offers tangible incentives for African countries to continue their efforts to open their economies and build free markets. Included in this website are a few the resources African businesses can use to either search or post information on the products or services they wish to sell. Unless otherwise noted, the services provided by these websites are free.

http://www.customs.gov/
"The United States Customs Service is the primary enforcement agency protecting the Nation's borders. It is the only border agency with an extensive air, land, and marine interdiction force and with an investigative component supported by its own intelligence branch."

http://www.customs.gov/impoexpo/impoexpo.htm
"This section provides an overview of importing and exporting issues related to the U.S. Customs Service. You will find links with information on duty rates, HTS, rulings and regulations, small importer, publications and forms."

http://apps.fao.org
FAOSTAT is an on-line database which contains over 1 million time-series records covering international statistics for horticulture.

http://www.ghanavegfairtrade.com
For some ideas of the types of fresh produce being exported from Ghana to the U.K.

http://www.produceworld.com
Membership is free of charge, and members can list their produce for sale online or search ProduceWorld's classified listings for brokers or wholesalers interested in buying fresh or processed produce.

http://www.pma.com
The Produce Marketing Association, founded in 1949, is a not-for-profit global trade association

serving over 2,400 members who market fresh fruits, vegetables, and related products worldwide. Its members are involved in the production, distribution, retail, and foodservice sectors of the industry.

- *Food Safety Information*

http://www.fda.gov/
http://www.fda.gov/ora/import/default.htm
"Stated most simply, FDA's mission is to promote and protect the public health by helping safe and effective products reach the market in a timely way, and monitoring products for continued safety after they are in use. Our work is a blending of law and science aimed at protecting consumers.

With the exception of most meat and poultry, all food, drugs, biologics, cosmetics, medical devices, and electronic products that emit radiation, as defined in the FD&C and related Acts, are subject to examination by FDA when they are being imported or offered for import into the United States. Most meat and poultry products are regulated by the U.S. Department of Agriculture."

http://www.cfsan.fda.gov/~lrd/pestadd.html
Center for Food Safety and Applied Nutrition - Any pesticide used in growing and post-harvest treatment of each produce item must be registered for use in the United States for the particular produce item. Pesticide residues must not exceed established limits.

Email: Eab38@cornell.edu
Cornell University's Good Agricultural Practices Program offers a free copy of a grower's guide entitled Food Safety Begins on the Farm: Good Agricultural Practices for Fresh Fruits and Vegetables.

http://www.cce.cornell.edu/publications/agriculture.html
Cornell University's Media Services Resource Center can answer e-mailed questions on farm level food safety practices. Send your questions to: resctr@cornell.edu

- *Post-Harvest Handing Practices*

http://postharvest.ucdavis.edu
At this University of California (UC) website you will find a wide range of fact sheets on individual fruits and vegetables, temperature recommendations for storage, links to suppliers of post-harvest equipment and many reference articles on the post-harvest handling of perishables.

http://www.fao.org/inpho/
This United Nations website includes a variety of FAO and other publications that users can browse on-line or download for their personal use. The UCDavis training publication. Small-Scale Post-harvest Handling Practices: A Manual for Horticultural Crops (3rd edition) provides cost-effective recommendations on improved handling of fruits and vegetables from the farm to the market. Other publications focus on packaging, storage, marketing or training and extension.

http://www.bae.ncsu.edu/programs/extension/publicat/postharv/
This website sponsored by North Carolina State University offers information on post-harvest cooling and storage options for many commodities.

http://anrcatalog.ucdavis.edu
This website describes the many publications, slide sets and videos on agriculture and horticulture developed and offered for sale by the University of California. There is also a long list of free publications available to browse or download.

- *Organizational Development Resources*

http://www.cipe.org/
"The Center for International Private Enterprise (CIPE), an affiliate of the U.S. Chamber of Commerce, works to build democracy and market economies throughout the world. CIPE works in four principal areas: a grants program currently supporting over 90 indigenous organizations in developing countries, an award winning communications strategy, training programs, and technical assistance through field offices."

http://www.cipe.org/vba/
"Virtual Business Association--This is an online source of valuable information for improving non-governmental associations. You will find *best ideas, sample documents,* and *resources* for five department managers of successful organizations."